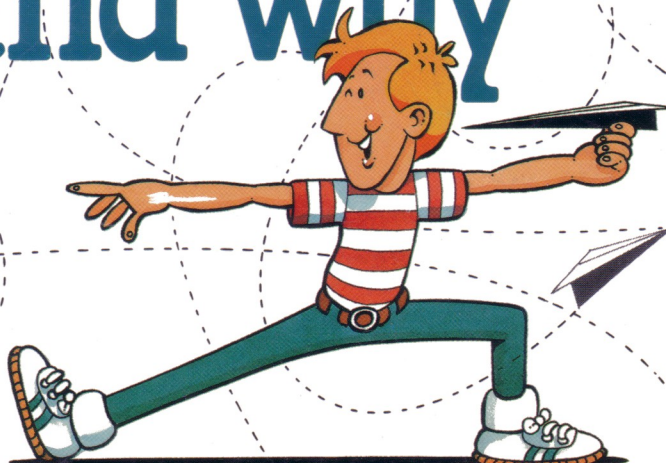
VISIT…

CAMPBELL MORRIS

Advanced Paper Aircraft Construction Mk III

12 high performance models and why they fly



CAMPBELL MORRIS

Advanced Paper Aircraft Construction Mk III

INTRODUCTION 2

THE CORRECT PAPER TO USE 2

EXPLANATION OF SYMBOLS 2

FOLDING TECHNIQUES 3

BASIC FLIGHT THEORY 4

THE ART OF THROWING 4

ADVANCED CONCEPTS IN PAPER PLANE DESIGN 6

TROUBLE-SHOOTING 7

Simple Distance Glider 8
Folded correctly, this dart-like plane will out-fly any normal glider.

Incredibly Simple Glider 10
You can whip up one of these in no time to throw at your nearest politician, lawyer, accountant or anyone you happen to dislike at the time.

Deluxe Glider 12
A smooth, elegant glider that loves breezes, upward draughts and long, leisurely flights.

Winged Wonder 14
This one will really get your head spinning as you try to figure out where it's going to land.

Superior Stunt Performer 16
An amazing craft for aerial stunts. It just keeps coming back!

Distance Achiever 18
You can annoy people from a distance with this one.

Smooth Flier 20
A simple glider to make and it flies incredibly well — even the teacher will be impressed!

High Performance Dual Glider 22
Two planes in one!

Not-so-simple Glider
A bit fiddly to make, but the results make it all worthwhile.

Windcheater 26
This craft will fly straight through not just moderate winds, but through any kind of pollution.

Litewing 28
Lightweight and long-flying, this is truly a dart of the eighties.

Ace Flier 30
It is a paper airplane in every sense, with its lookalike wing and tail section — all made from a single sheet of paper!

The Hangar 32
For the paper plane enthusiast who has everything.

ANGUS & ROBERTSON PUBLISHERS

Introduction

Welcome to the world of high performance paper aircraft. This book represents the pinnacle of paper airmanship. Gone are the days of pure aerial fun from the back of the classroom. Now you can create sophisticated paper "machines" — designs that go beyond fun and games to the world of theory and ingenuity, designs that challenge even the most fundamental laws of physics.

Now imagine it's the not-too-distant future, and that you have a career in aeronautics, aircraft building, computer-aided design of space weaponry or shuttle craft. You could even be a pilot flying the new orbital space craft that carries passengers from Sydney to London in less than two hours. The designs that follow this long-winded introduction could be the launching pad for those careers, just as the apple inspired Newton, the flight of birds the Wright brothers and the movement of sub-atomic particles Einstein. So next time your teacher, boss, fellow cabinet member or mother dismisses you for throwing a paper plane you can reply: "It's my first step to a new career in flight!" (be it as wing commander, astronaut, toilet cleaner, etcetera).

This book is designed to let you think for yourself. It offers first-hand experience in aerodynamics by giving plenty of scope for experimentation and creativity.

You are tomorrow's pioneers. Don't be discouraged by those who say "you can't do it". Some people I know go so far as to talk of a "nuclear Armageddon"; they say, "What's the point of joining the airforce when the very technology that built the Space Shuttle brings nuclear missiles to our doorstep?" But believe me, if you're serious about flight, put aside the negative attitudes. Just think, if we can go beyond the boundaries of our doomsday-minded planet and forget our hidebound ways of seeing, we could reach the endless limits of outer space and so realise the ultimate destiny of the human race!

None of my planes go that far, of course, but I sincerely hope my humble book will give you the inspiration to take to the skies — no matter how old you are.

Happy folding — happy flying.

The Correct Paper to Use

All the aircraft in this book use quarto or A4 (210 x 297mm) or foolscap paper. Make sure you use thin but strong paper. Never use anything like newspaper, which is not strongly bonded and therefore cannot hold a fold. If the paper is too heavy, it might inhibit the more complicated folds shown in this book.

Explanation of Symbols

These symbols are very important if you are to succeed in folding. I have simplified them to avoid confusion. Before you start folding, practise first with small pieces of paper (not money).

Fold in general direction of arrow.

Turn the model over.

Cut along dotted line.

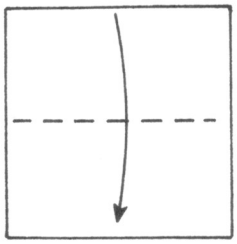
When this valley fold has a dotted line it means that the rest of the fold is hidden behind a flap.

Push in.

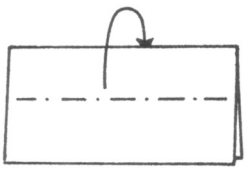
Folding Techniques

The technique of folding goes hand in hand with the following of symbols (unless you're crunching up a piece of paper to throw at someone). So grab a small piece of paper and try these tricks:

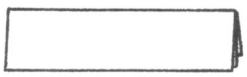
1.
Valley fold — fold in direction of arrow along the line of dashes.



2.
Mountain fold — now fold the top end behind, in direction of arrow, along the line of dots and dashes.

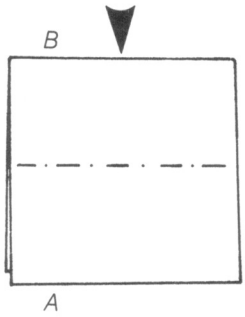


3.
It should now look like this piece of totally useless paper.

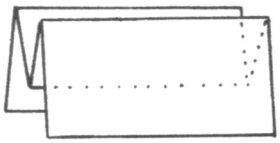


Now grab a longer piece of paper and fold it in half.

1.
See the line of dots and dashes? Well, fold along this line backwards and forwards until the paper is well-creased, then holding the lower end A with thumb and finger, push in the other end B to meet the edge A.

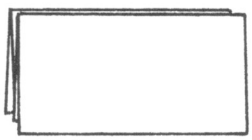


2.
Yes . . . it's almost there.



(DOTS SHOW HIDDEN FOLD)

3.
Wow, you got it right! Flatten the paper. You have just completed an inverse fold.



If you want to learn more about paper folding and exchange ideas with other devotees of the art, write to:

Dave Brill
British Origami Society
12 Thorn Road
Bramhall, Stockport
SK7 1HQ England

Despite its name, the Society boasts members in all parts of the world, including the home of paper folding, Japan.

Basic Flight Theory

"Oh yuk" I hear you say — but to understand how your plane flies is a step in making your plane fly well.

There are four basic forces that control the flight of a paper plane (or any plane for that matter). These are lift, drag, gravity and thrust. Lift is a force that pushes an aircraft upwards against the force of gravity. Drag is the normal force of air opposing an aircraft's forward motion. Gravity is a natural force that pulls an aircraft to the ground. Thrust is a force that propels an aircraft through the air, opposing drag. Thrust is created by an aircraft's propeller or jet engine. In paper planes it is created by the motion of your arm throwing the plane.

In figure 1, *the kinetic energy of thrust from your arm has propelled the glider in the direction (the intended glide path) you wish it to go. It is met by air resistance — drag — and the glider's lift is temporarily greater than gravity, making it climb. As the kinetic energy expires, gravity overcomes lift and your plane glides to the ground.*

Lift is created by a drop in air pressure above an airplane's wing. An airplane's wing has a curved upper surface so that while air moves over the wing its speed increases and causes a pressure drop. The air under the wing remains at normal pressure, so the wing can only go upwards.

The stability and control of an airplane is another factor well worth noting. An airplane has three basic movements: yaw, roll and pitch. A plane makes each movement on an imaginary axis that passes through the centre of gravity.

In figure 2 *we can see that yaw is a plane's movement on its vertical axis as its nose turns left or right. Roll is a plane's movement on its longitudinal axis as one wing tip drops lower than the other* (figure 3). *Pitch is a plane's movement on its lateral axis as the nose moves upwards or downwards* (figure 4).

A paper aircraft can have many controls to allow it to perform the way you want it to. Some of these are tail fins, wing fins, rudders, elevators (rear wing lift), ailerons (forward wing lift) and a whole lot more. Refer to the "Advanced Concepts" section to find out more on controlling an aircraft's flight pattern.

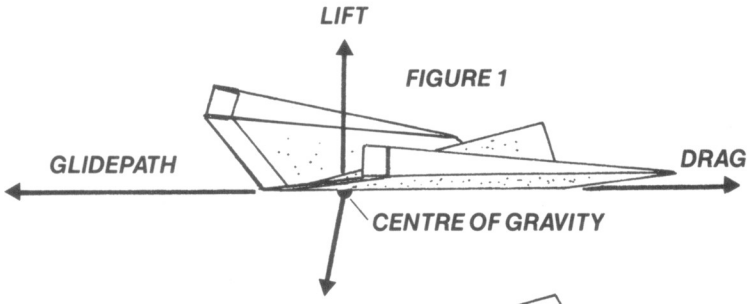
I hope this will give you a good idea of what it's all about. These are only the basics and I hope you will take time to visit your local library to find out more on flight theory.

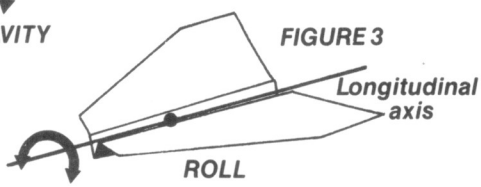
The Art of Throwing

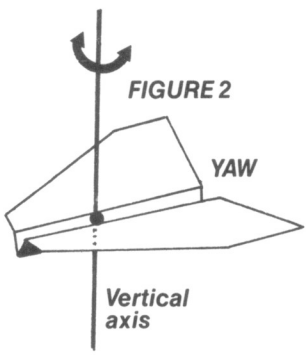
Once you've mastered the folding of paper planes, you'll soon realise there's much more to them than folding — it's throwing that takes real skill. If you want to be the envy of your class mates, fellow politicians, brothers in the church, etcetera, you'll need to be proficient in throwing techniques.

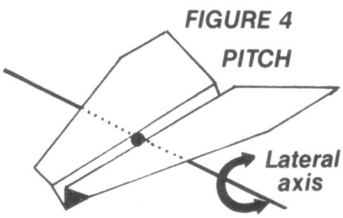
Basics first. You must make sure that your plane can fly straight. This depends on the plane's symmetry. To ensure this symmetry you need to start right at the beginning — with the first fold you make. It is important to fold the model in half either lengthwise or widthwise to get a centreline crease. The best way to do this is to bend the paper over so that the corners meet, and then to spread your fingers across the edge from the centre outwards to make the crease.

Each plane in this book is thrown in a different way — and some can be thrown in a variety of ways.







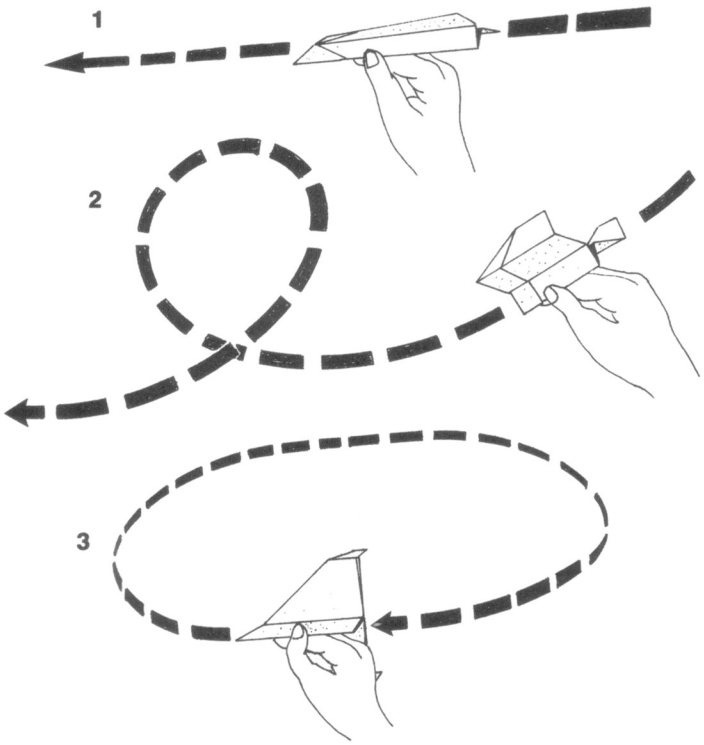


1. To throw a plane normally, grasp the centre area of the fuselage with your thumb and index finger, and with your arm move the plane in a forward direction (at the desired speed depending on the type of paper plane selected) and let go. Remember that the wings should be level and that the same level is to be kept until release point.

2. To make your glider loop is relatively simple. Loops are better suited to craft with wider wingspans. By adjusting tail fins or curling up wing ends to give more lift you will have a plane best suited to looping. By holding the fuselage with thumb and index finger and looking down the fuselage with your eye you are now ready to throw. Throw with force (as if you're throwing a rock at someone . . . not that I suggest you do that!) and then let go. It should loop, provided that balance and direction are correct. Sometimes wind direction can alter the plane's looping performance. I suggest you practise and experiment to increase your skills.

3. Some planes in this book are designed to circle horizontally or even in "circle loops" — diagonally — to the ground. Grasp your plane with thumb and index finger near the forward end of the fuselage, the aft end resting against your hand. With the underside of the plane facing your body throw with force towards your left (left-handers throw in opposite motions). Make the angle of attack slightly higher than normal — about 20 degrees above horizontal. It should circle well provided lift, angle of attack and thrust are correct. Practice makes perfect!

Catching upward breezes can be enjoyable. Make a glider with a wider than normal wingspan and plenty of lift.



Looking down the glider from aft to forward, angle the glider at about 40 degrees. By holding the fuselage with thumb and index finger thrust the glider in an upwards arc away from you and parallel to the wind direction. As the glider flies across the wind it gains altitude without stalling and is carried away with the wind. The beauty of designs in this book is that you can fold a glider in a short space of time from a single piece of paper — so if you lose the glider in flight you can easily make another.

Distance flying is another interesting aspect of paper planes. The right conditions for distance flying (particularly in competitions) are still air and level ground. Darts are better suited initially, but their flight can be interrupted by many things such as turbulence. Darts are great if you have a strong arm and can throw the plane far; but don't be fooled, wider wingspan gliders made by clever designers have achieved great distances. Making sure that your plane flies straight, throw with moderate force in a slightly higher angle to horizontal (about 10 degrees). Keeping your arm straight, let go. Do not throw at a higher angle, as some people counsel, because your glider could stall and dive to the ground — making no distance at all!

Lookouts at tops of buildings or in mountainous areas are ideal for sustained flight. A paper plane can stay up in the air for over half an hour, gently "floating" on air currents as it finally becomes a white dot in the distance. Believe me — I've done it!

Finally, keep practising wherever you are; I've done so for years now and I'm not sick of it yet!

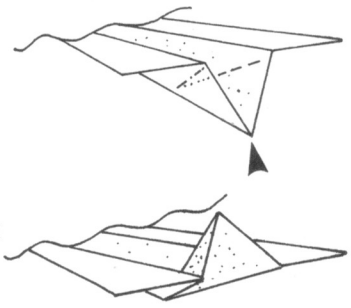
Advanced Concepts in Paper Plane Design

A plane flies or doesn't fly because of its shape. A piece of paper drops to the ground — but it does so in a certain way, wafting in the air in unpredictable directions. It takes slightly longer for a piece of paper to fall to the ground than, say, a brick because the paper is light enough to meet air resistance.

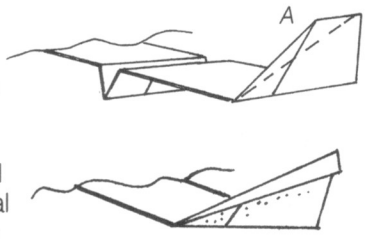
Different paper planes fly with different mannerisms simply because of their shape and what they're intended for. A dart is designed to fly in a certain direction and to meet less air resistance. A wing, on the other hand, tackles air resistance in such a way as to gain lift or perform stunts.

Either way, there are many applications and modifications you can make to a paper plane if for some reason it won't fly the way you want it to, or if you want to "program" its flight path. Here are just a few ways in which you can alter your paper plane.

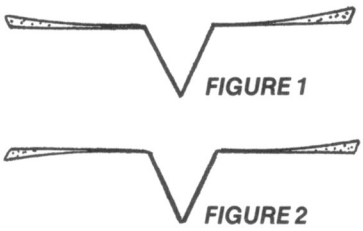
Concept 1. Fin/Rudder:
This is basically a specialised inverse fold (see "Folding Techniques"). As shown at the rear end of the dart, the fuselage end is pushed inwards, the fold being inverted to form a fin. This can provide lift and produce a more direct flight path.



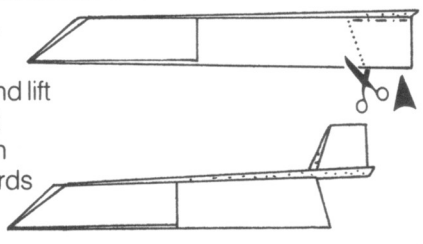
Concept 2. Adding lift to wing/fins:
Simply fold leading edge of fin A downards; the new flap is now a flat area where air resistance strikes (at the folded angle) giving lift. This is an ideal fold if you wish to make gliders loop.



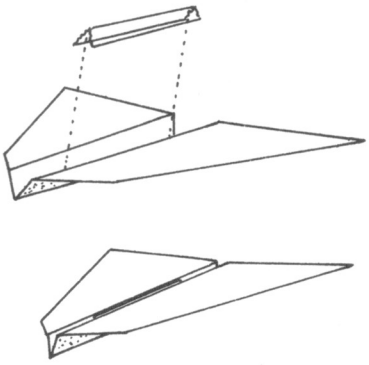
Concept 3. Tail lift:
If your paper plane dives to the ground, or if it doesn't go in the direction you want it to, gently curl up the left tail or the right tail (or one curled up more than the other) depending on whether the dart glides off-course to the left or right (figure 1). This will give the plane more tail lift. If your dart still veers off you can even curl down one of the rear wing tail sections as shown in Figure 2. However, bear in mind that tail lift causes drag and erodes the performance of your glider. A better way would be to start folding a new plane, carefully noting the symmetry of your folds.



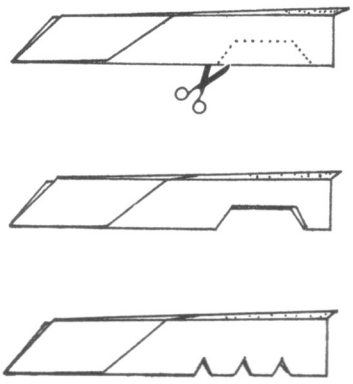
Concept 4. Horizontally inverted fin:
A novel way to add style and lift to a conventional dart. Cut along dotted line and push fuselage end in and upwards to form fin/rudder.



Concept 5. Sealing of fuselage:
This method is used by many professional paper plane enthusiasts who enter their models in competitions. The open part of the fuselage is sealed to give greater speed and agility. The best way to do this is to use a length of sticky tape equal (or slightly less) to the length of the fuselage: fold it in half lengthwise and place it so that the wing edges of the fuselage are sealed together.



Concept 6. Lightening fuselage tail end for stability:
In many darts, the fuselage is so long that it causes the dart to roll (see "Basic Flight Theory"). By cutting out small sections one can experiment to get the best balance and stability from a dart. Several small cut-out sections rather than one long cut-out section ensure the correct alignment of the dart, eliminating warping.



There are many other concepts and ways in which you can increase the performance of gliders and darts. Experimentation is the name of the game and I encourage you to try some modifications of your own.

Troubleshooting

Won't fly? One way to solve that problem is to light a match to your glider and watch it go down in flames. The better alternative is to go back through all the folding steps as you unfold your glider and see where you went wrong. In many cases it's lack of symmetry. Whatever you fold on the left-hand side of a piece of paper, you must do exactly the same on the right-hand side. It's a good idea to grab a steel rule and measure folds on both sides. In time, you'll be able to judge symmetry pretty well. Other reasons why a paper plane won't fly are:

1. *Not thrown properly.*
2. *Too windy.*
3. *Wrong type of paper used.*
4. *Wrong dimension of paper used.*
5. *Too much lift, too little lift, too nose-heavy.*

Of course, it will take time before you master paper plane technology (and move on to more meaningful things) so take it slowly and you'll thoroughly enjoy every paper plane you make.

Simple Distance Glider

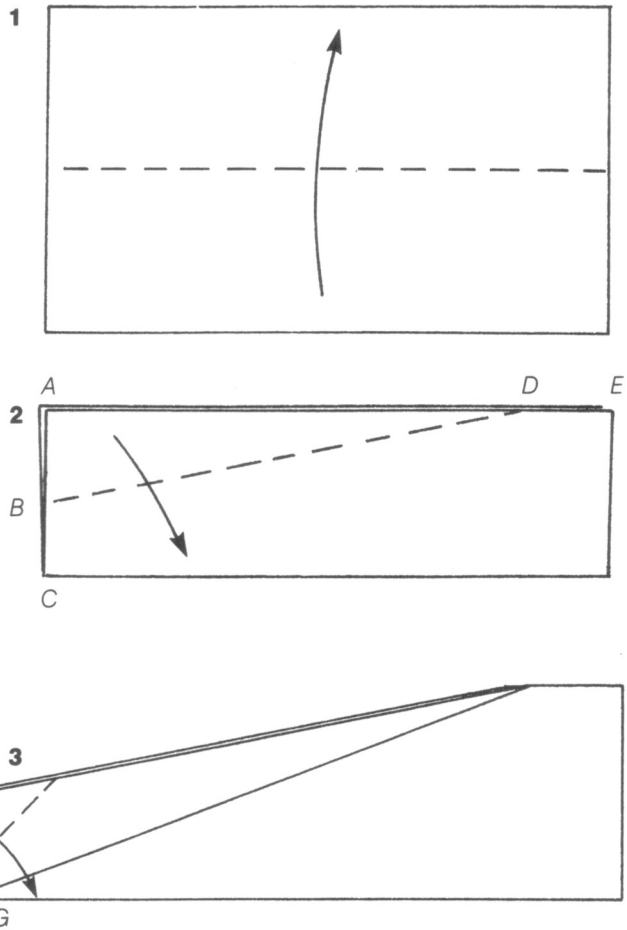
Looks like a dart, smells like a dart . . . but you ain't seen nothing yet! This craft will out-fly any normal glider given the right conditions and folded correctly.

1.
Use a sheet of foolscap facing you lengthwise and fold upwards in half.

2.
Fold down flap — point A should come to rest on folded edge. The distance between B and C should be equal to the distance between D and E (about 5 cm). Do the same for the other side.

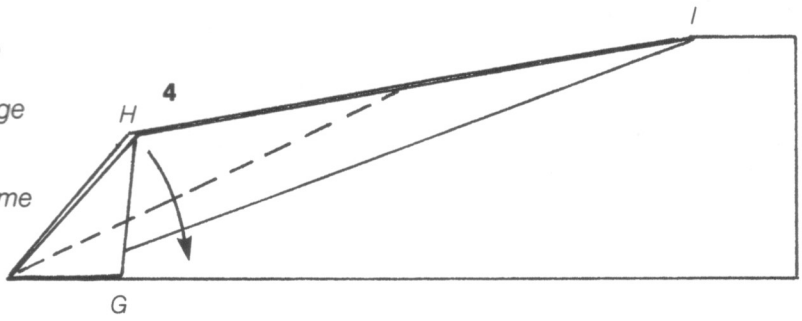
3.
Fold flap down so that edge F rests along edge G. Repeat for the other side.

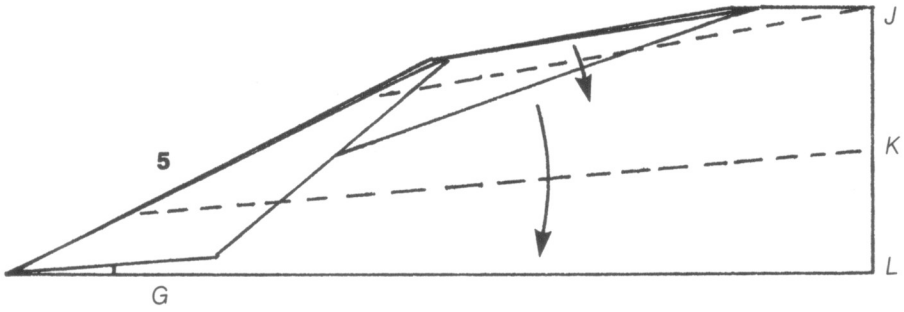
4.
Fold nose down to almost *meet edge G. The fold should be from the nose tip to halfway between H and I. Repeat for other side.*

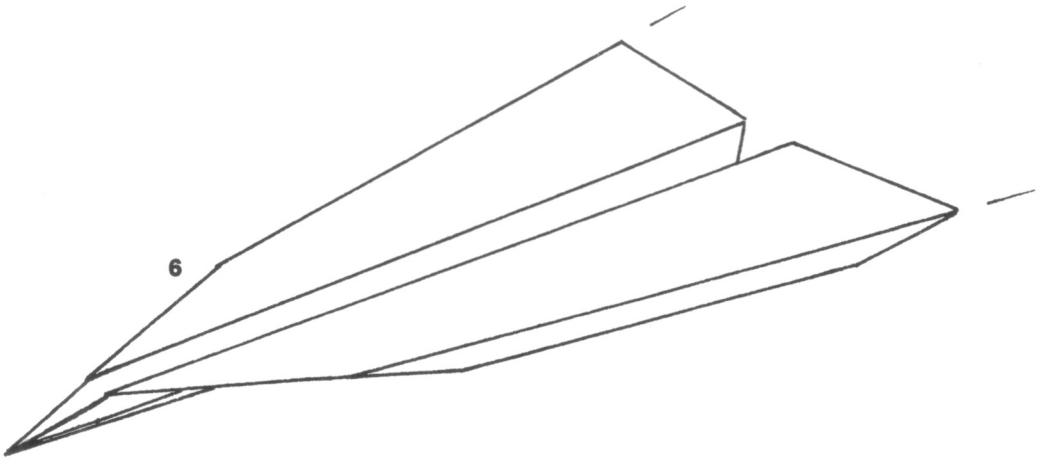


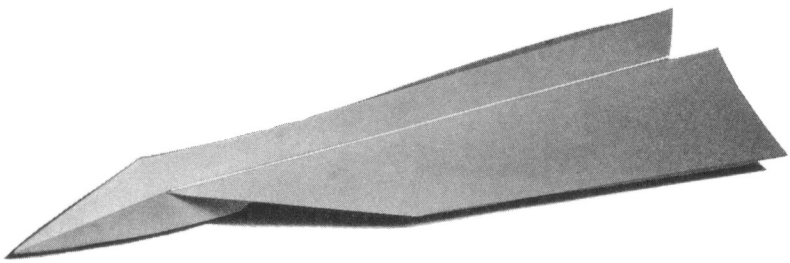
5.
Fold down wing fin parallel to wing edge (to point J). Then fold wing section down to edge G. Folded edge of wing fin (along line J) should come to rest along edge G. Do the same for the other side.

6.
Bring up the wings (to a "Y" shape as you look at the dart head on — which is the case for most gliders) and you are ready to throw.





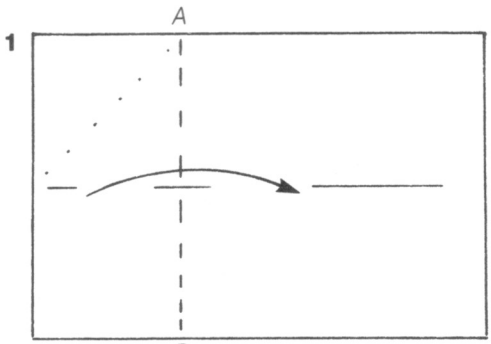




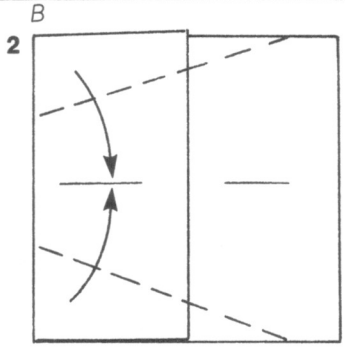
Throwing Instructions
Throw at a level angle to the nearest person in authority. It should glide gracefully. Alternatively you may wish to apply Advanced Concept 5, sealing the fuselage with tape to increase speed — and surprise someone!

Incredibly Simple Glider

This glider is so simple even my mother can fold one! It's a beaut little glider because no matter where you are you can whip one up in no time to throw at your nearest politician, lawyer, accountant or anyone you happen to dislike at the time!

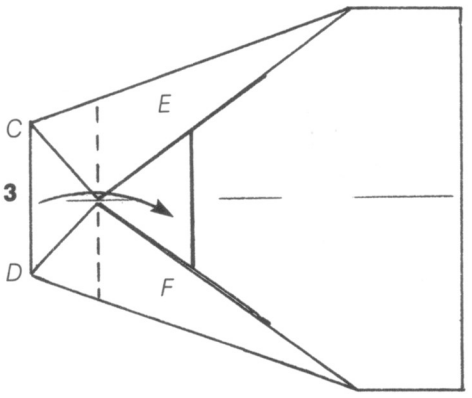


1.
Fold paper in half lengthwise. See the line of diagonal dots? Bend one corner of your A4 sheet along that line and crease one end, A. This will establish the position of your first fold. Now fold along line AB.



2.
Fold sides in to meet centre crease as shown.

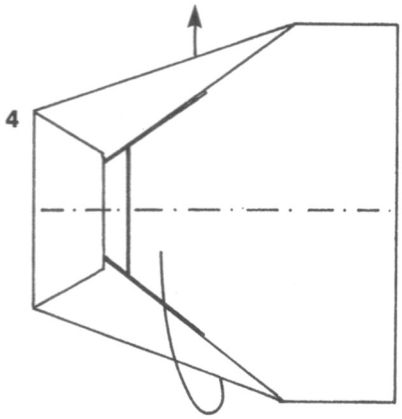
3.
Fold nose in so that corners C and D meet edges E and F.

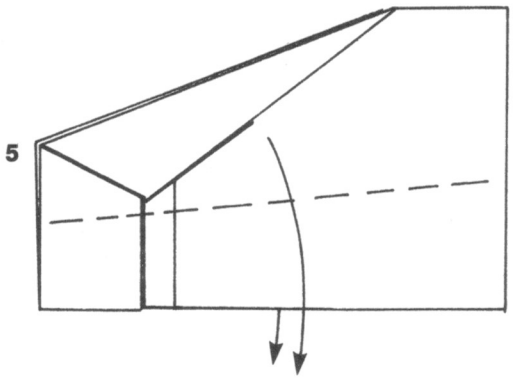


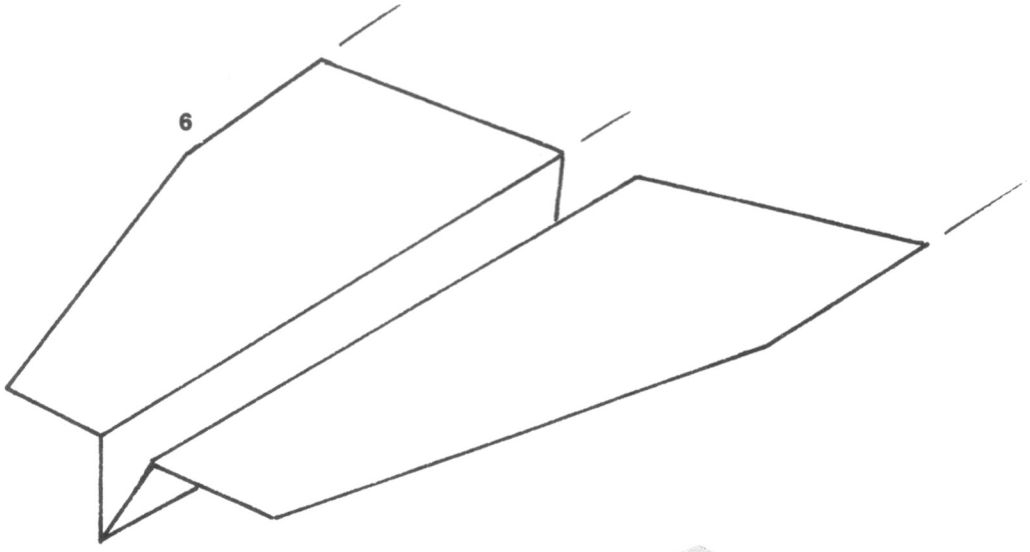
4.
Mountain fold the glider in half.

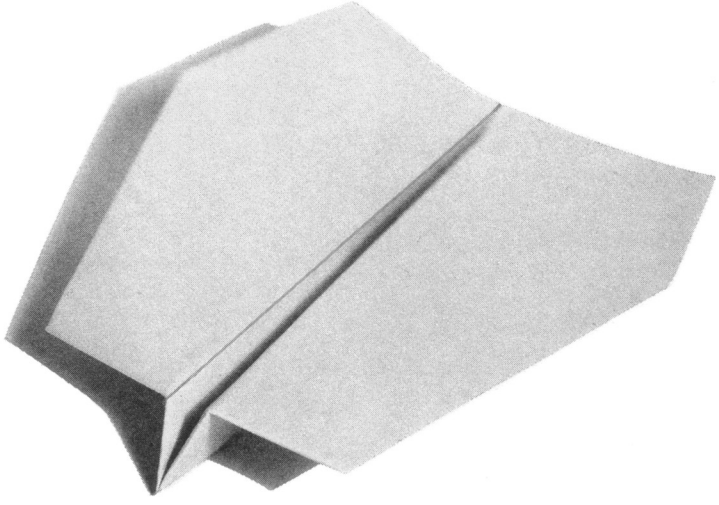
5.
Fold down the wings in roughly the same position as shown.

6.
Your Incredibly Simple Glider is now ready to throw.









Throwing Instructions
Throw at level angle and gently. Do not throw hard as the fold may open out. However, by applying one or more of the Advanced Concepts, this glider can fly faster. I'll leave it to you to work out which concept to use.

Deluxe Glider

A smooth, elegant glider that loves breezes, upward draughts and long, leisurely flights. Once I threw one from a seaside residence and the wind just carried it along the coastline — to finally land in someone's swimming pool!

1.
Fold sheet of A4 or foolscap paper in half lengthwise.

2.
Fold down first flap. Repeat on other side.

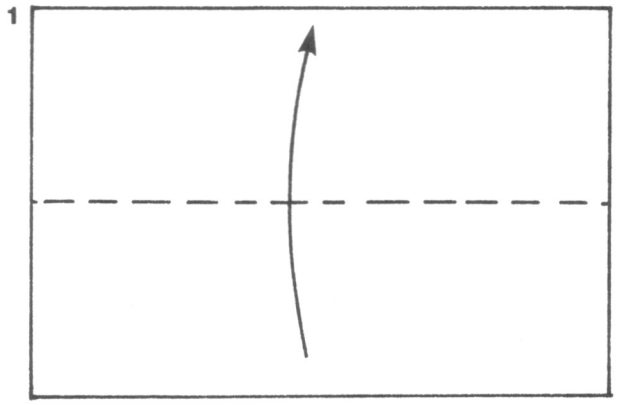
3.
Fold down second flap. Repeat on other side.

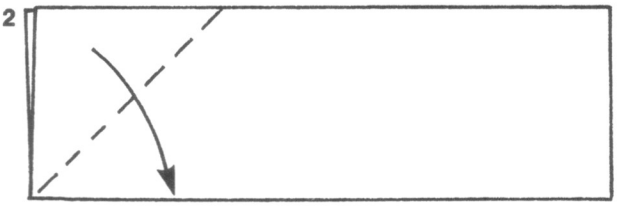
4.
Fold down wings in roughly level position. You may like to angle about 10 degrees down to nose end if you wish. The fuselage height should be no more than 2 cm.

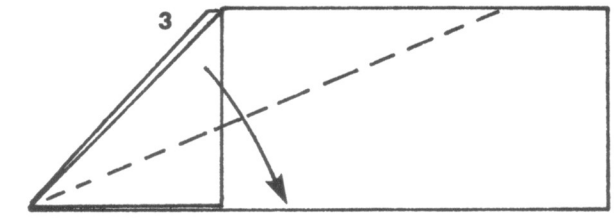
5.
Fold nose end first, then wing ends up as shown.

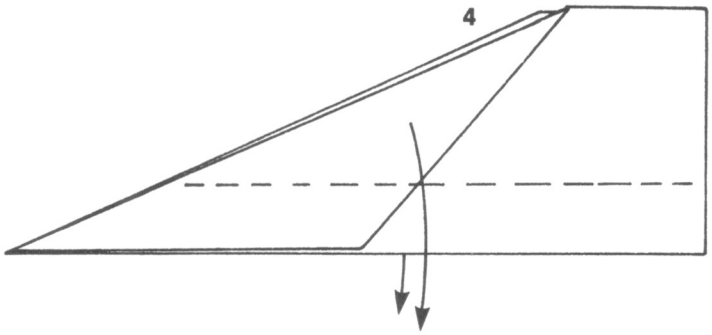
6.
Fold down wing fins parallel to wing fold. Give the fins about 2 cm width. Bring wings down.

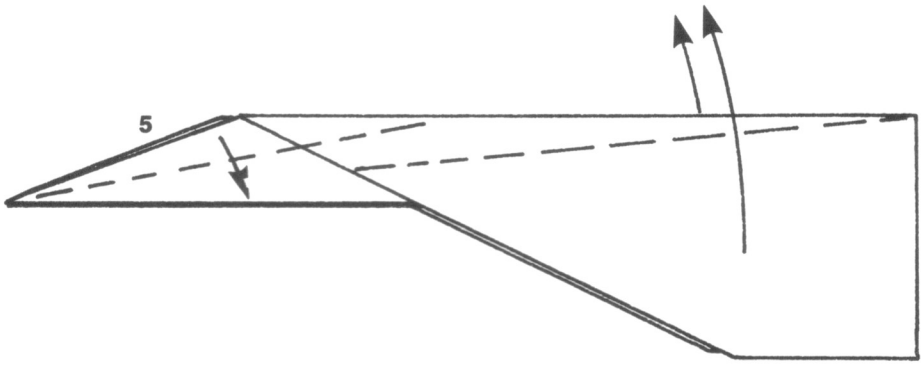
7.
The completed Deluxe Glider. Add tail lift if necessary.

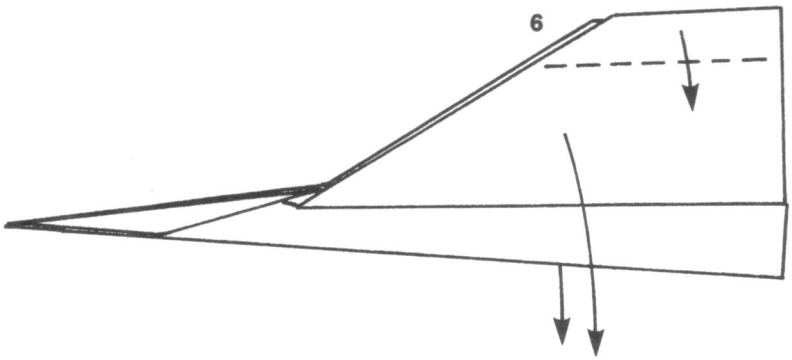






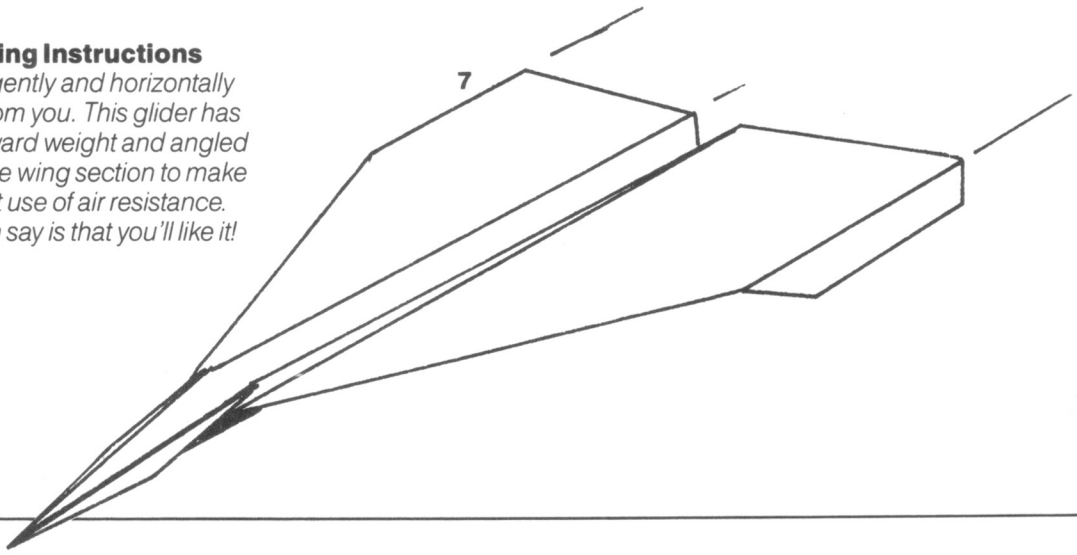






Throwing Instructions

Throw gently and horizontally away from you. This glider has the forward weight and angled lift on the wing section to make the best use of air resistance. All I can say is that you'll like it!



Winged Wonder

A wonderful paper wing that flies so well and is so simple to fold! This glider can really get your head spinning as you try to figure out where it's going to land. Stays up longer in the wind than other wings — and that's due to its large wing area.

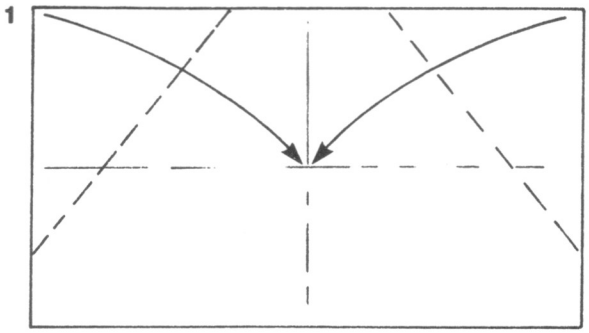
1.
Fold a foolscap or A4 sheet in half widthwise and lengthwise, but crease only the ends and the centre. You've now found the centre of the paper. Fold the top left and right corners in to meet the centre point.

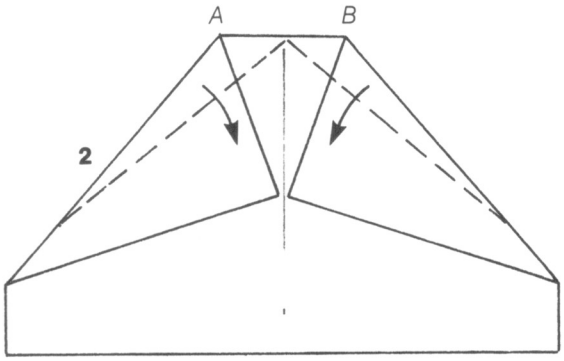
2.
Fold the new leading edges in as shown. Points A and B should meet the top end of the centre crease.

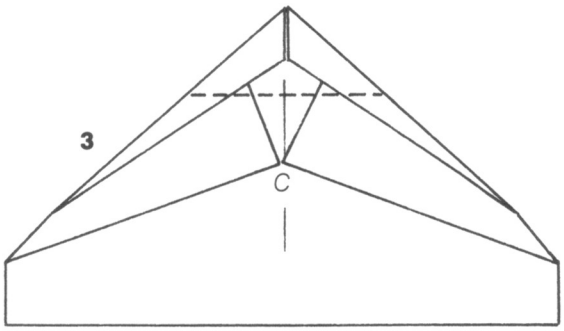
3.
Fold tip down to meet point C.

4.
Fold top end down to point C. Then fold along line that crosses point C. This will establish nose weight.

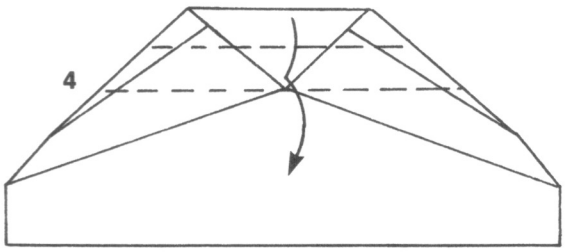
6.
Mountain fold up wing fins along line shown. Fold wing section down. The fuselage height should be approximately 2.5 cm.

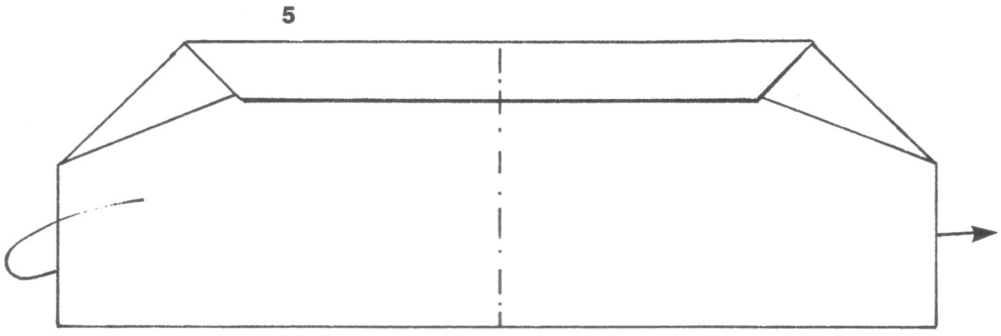


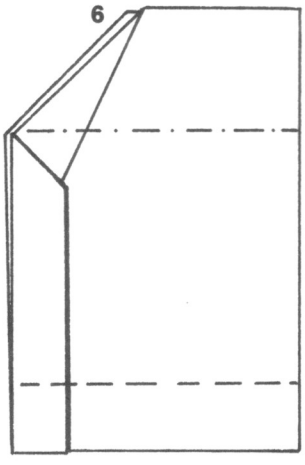


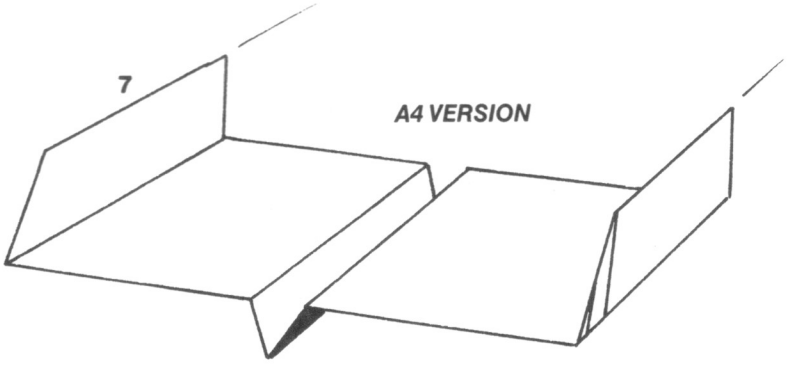


7.
The completed Winged Wonder.

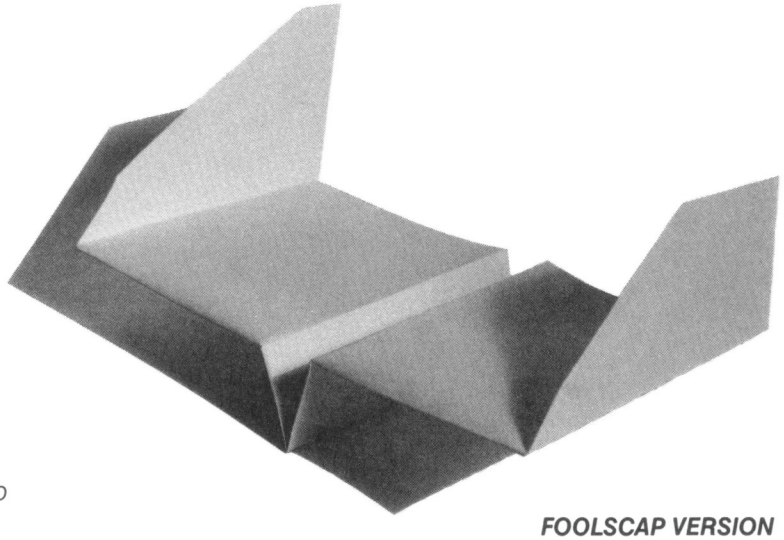








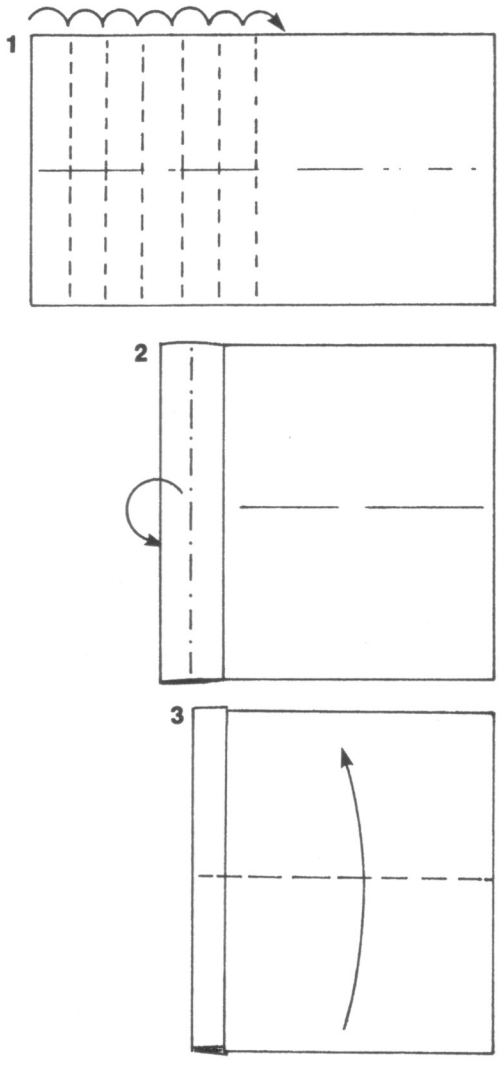
Throwing Instructions
It's so versatile! Gently throw forward in a slight downwards angle for a smooth glide. Add a bit of tail lift and you can throw to make loops and circles. Throw harder and upwards. If your Wonder suddenly dives, add more tail lift and refer to Advanced Concept 2 (and maybe others depending on how well you folded the model) to correct the situation. See also "The Art of Throwing".



FOOLSCAP VERSION

Superior Stunt Performer

This craft can do some amazing things. No matter how I threw it it kept returning to me. After doing a stunt, it would often be carried away in the wind. This is a great plane for outdoor concerts. You can write messages on it for your brothers-in-music, saying "peace", "nuclear disarmament" or "I hate this awful music!"



1.
Begin with a foolscap piece of paper folded in half lengthwise. Fold the end over about six times in approximately 2.5 cm folds each time. This should bring the last fold about half way across the page.

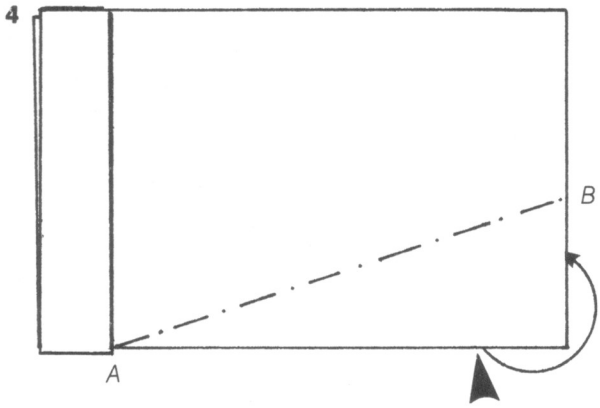
2.
You now have a firm edge of folded paper. Mountain fold the leading edge behind as shown.

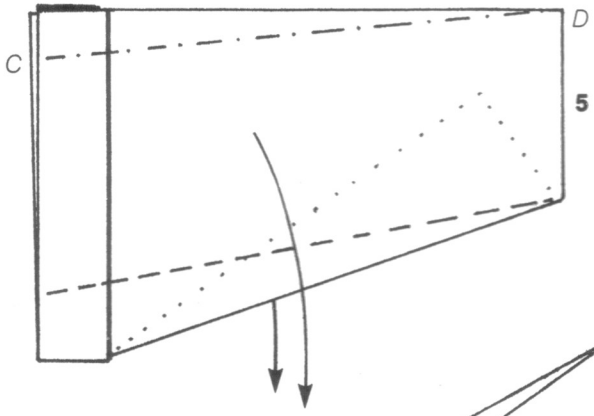
3.
Fold in half.

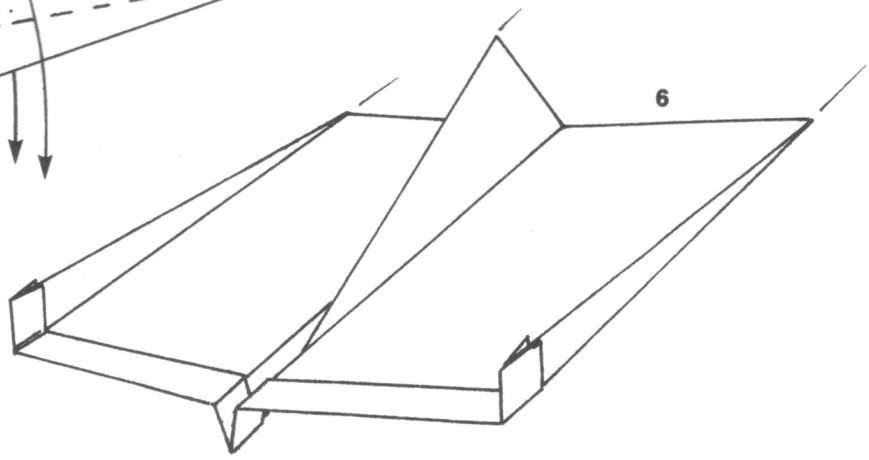
4.
Invert the bottom edge (see "Folding Techniques"). The fold should be from point A to point B which is about 4.5 cm above the bottom edge.

5.
The dots represent the hidden fold from step 4. Fold down the wings, right from the corner of the new tail fin to about 1.5 cm above the bottom forward edge. If you want a smooth graceful glide, your glider is ready. If you want a fast stunt performer, fold up the fins CD in a fold parallel to wing slope giving the forward leading edge of fin about 1.5 cm in height.

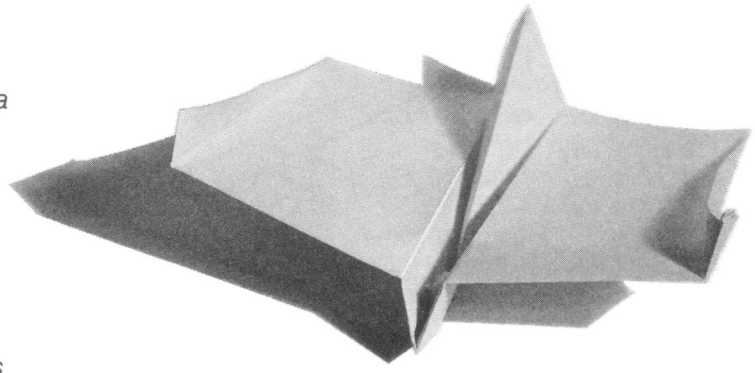
6.
Your Superior Stunt Performer is now ready to do its stuff!







Throwing Instructions
Make sure the folds are well-creased. This glider is more of a circle-looper. As you throw it to make a loop (see "The Art of Throwing") the glider climbs vertically, but just as it reaches its peak it turns sideways to return to you in a diagonal arc. To make a horizontal circle simply throw with force to your left and it will return to you — it's really quite a faithful flying beast!



Distance Achiever

All over the world, politicians are having trouble getting their paper planes (containing leaked information) across the floors of their respective parliaments. Very embarrassing when they fall into the wrong hands. I now have the solution to this problem.

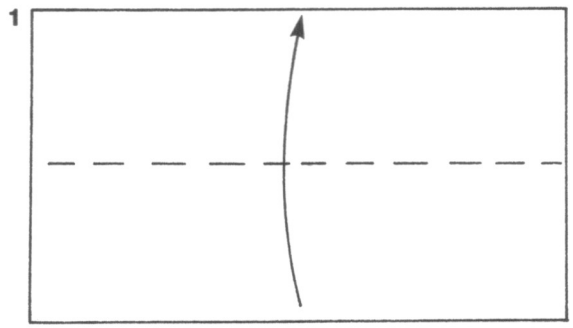
This dart has travelled great lengths and I hope to enter a secret modified version in a competition soon. Fold the dart, enjoy its flight and see if you can modify it to fly further.

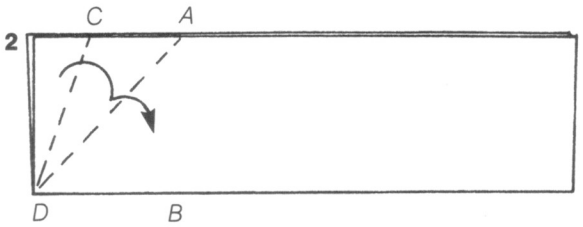
1.
Grab a sheet of foolscap and fold in half lengthwise (not you — the paper!).

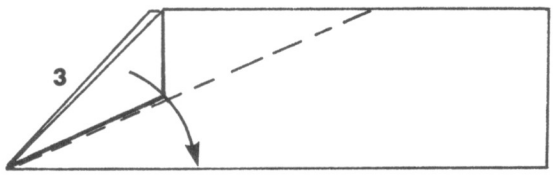
2.
Fold the corner down to B as in a normal dart, unfold, then fold the corner to the crease DA. Now fold along DA.

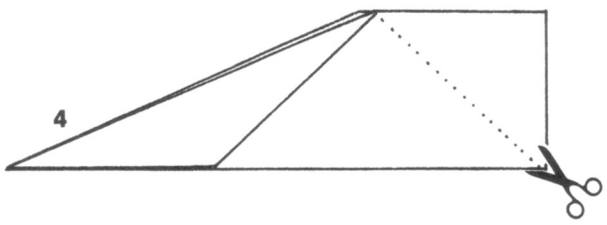
3.
Fold down as shown. Do the same for the other side.

4.
Cut along dotted line where indicated. You could use a ruler if you don't have scissors, tearing along the edge of the ruler. I'm so used to making planes, I just fold along the line and tear with my hands. Discard the unwanted pieces (or make little planes if you wish).







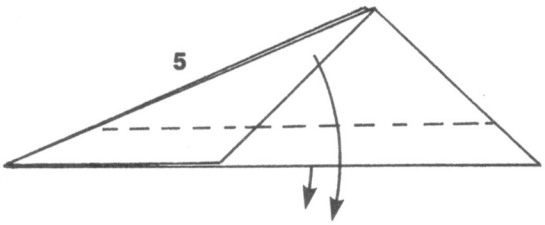


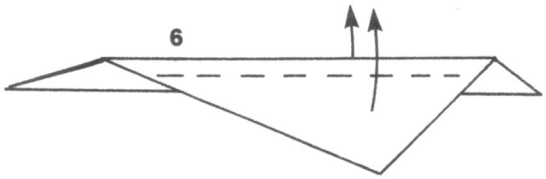
5.
Fold down the wings. Make the fuselage height about 2 cm.

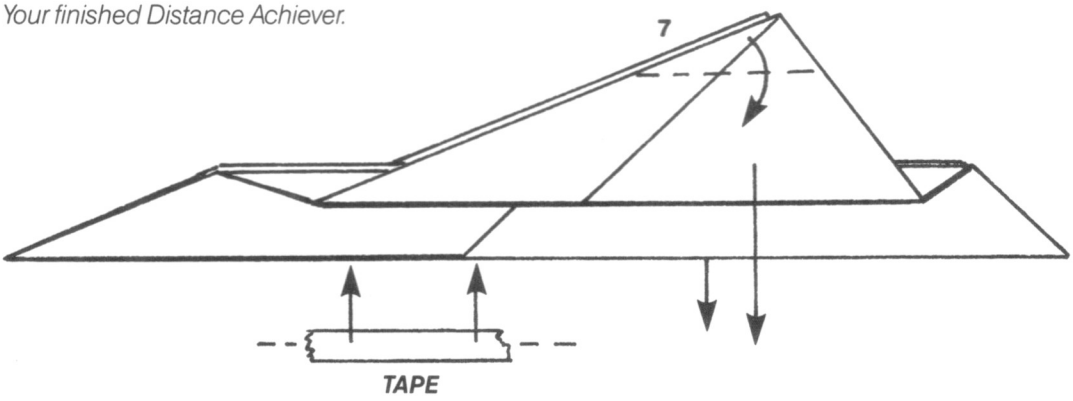
6.
Fold up wings along fuselage. You may wish to angle the wings about 10 degrees. This step can be ignored if you want a graceful smooth glide.

7.
Fold down wing fins and level the wings. The size of the fin may need to be adjusted for correct balance in flight. Experimentation is necessary. For better performance, the loose flaps on the fuselage can be sealed with sticky tape, although the craft can fly adequately without tape.

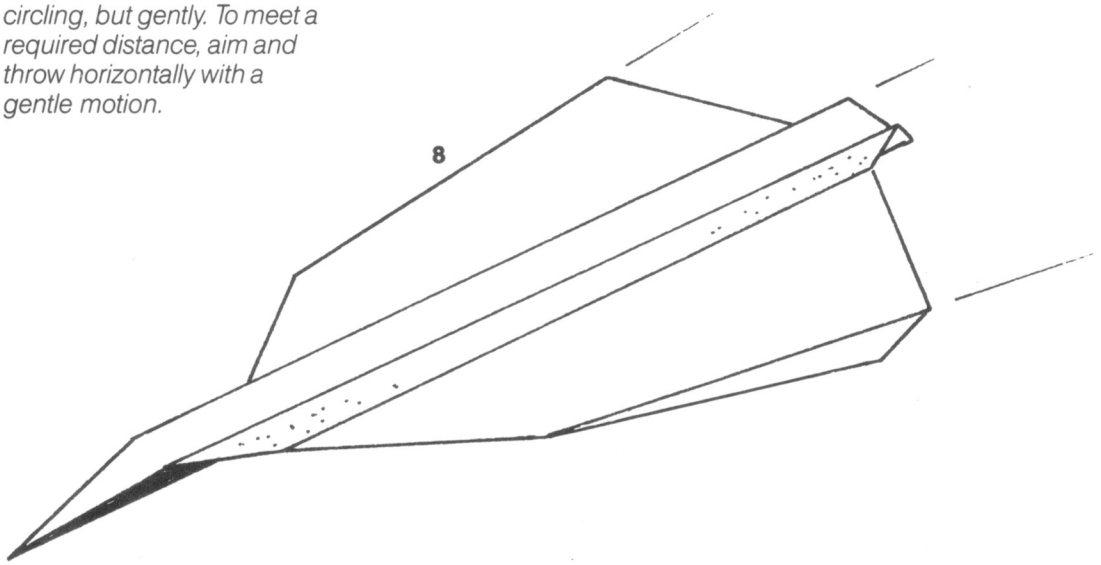
8.
Your finished Distance Achiever.







Throwing Instructions
For wide arcs, throw as for circling, but gently. To meet a required distance, aim and throw horizontally with a gentle motion.



Smooth Flyer

Your average, everyday kind of dart is unstable and unsuitable to prolonged smooth flying. Here is another glider that is so simple to make but flies incredibly well — even the teacher will be impressed!

1.
Use a sheet of A4 paper folded in half lengthwise. Fold the corners in as shown.

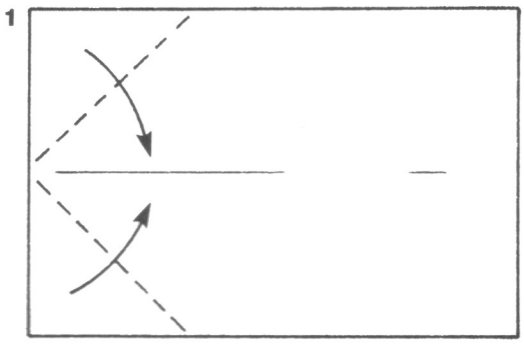
2.
Fold the leading edges in as shown.

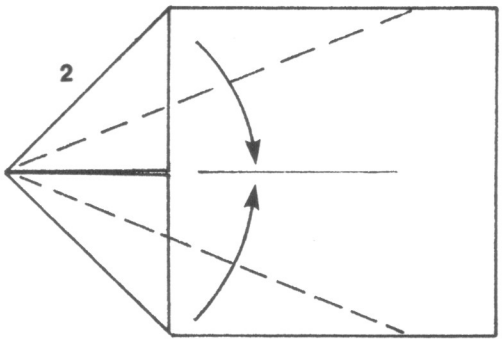
3.
Fold in half.

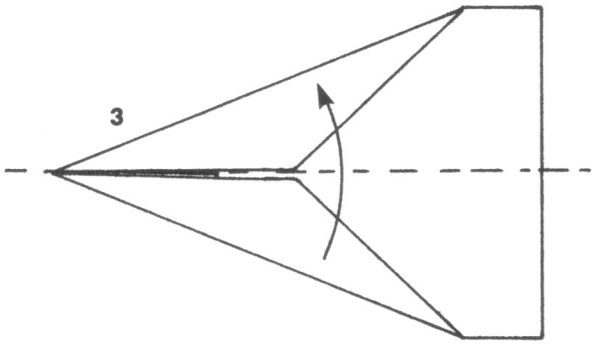
4.
Fold wings down, slightly angled as shown. Give the fuselage around 2 cm height. Both height and angle can be experimented with if you wish.

5.
Fold the leading edge of the wing into a long fin. The fin is shown folded upwards. You can fold the fin downwards for an even smoother flight. See which way you think is best. Bring the wings up for the next step.

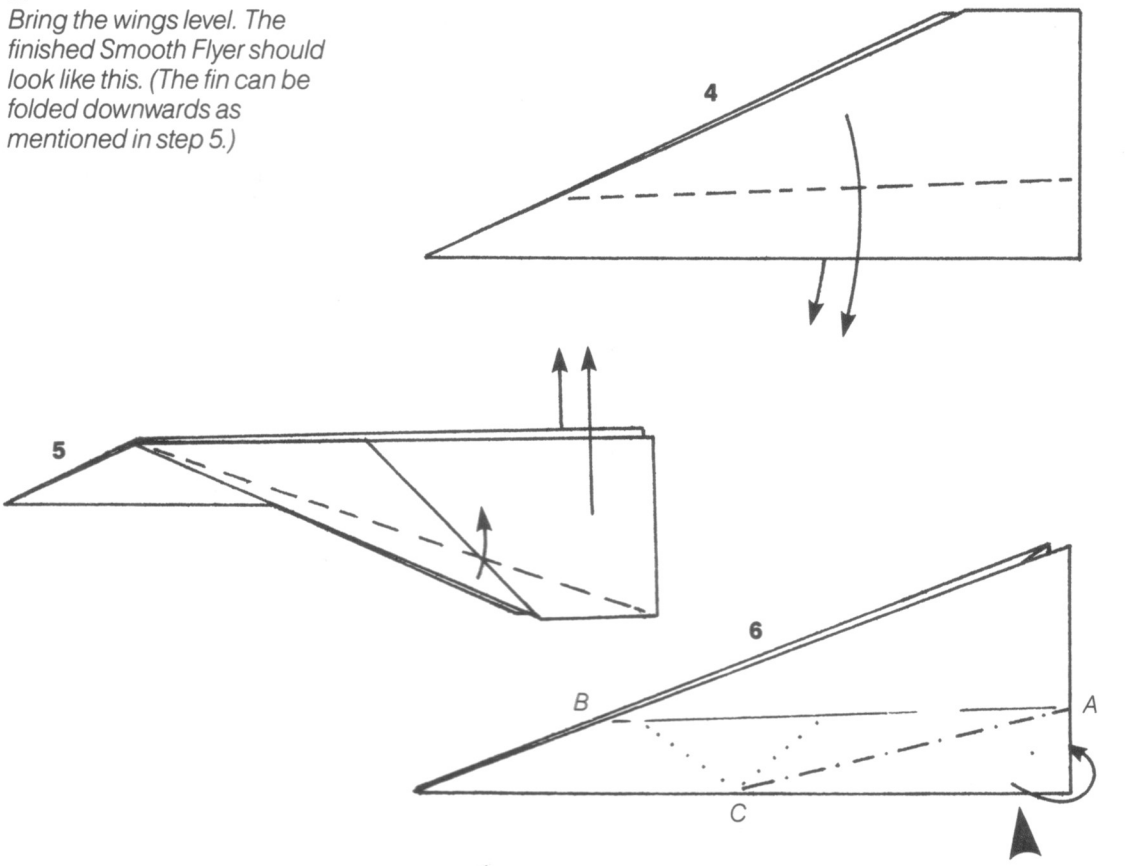
6.
Invert the fold. The dots show the hidden flaps inside the fuselage. Where they meet at the bottom edge of the fuselage is point C. Fold your inverted fin from point C to point A. A is the tail end of the wing crease AB. Of course you must crease CA well to invert the fold.

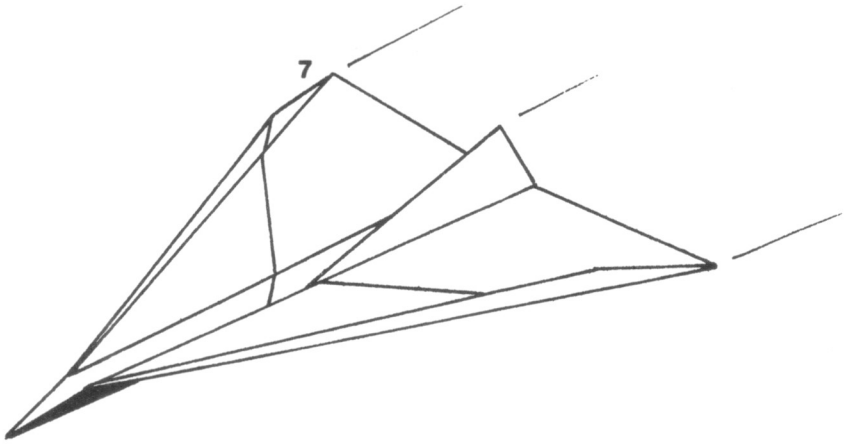


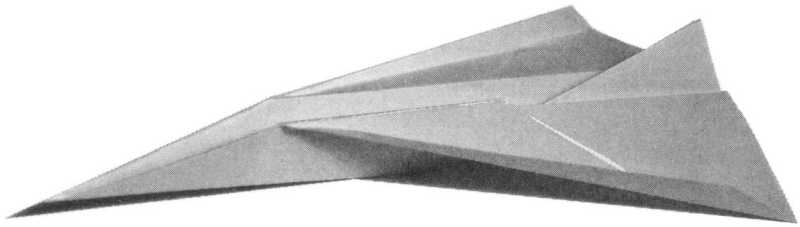




7.
Bring the wings level. The finished Smooth Flyer should look like this. (The fin can be folded downwards as mentioned in step 5.)







Throwing Instructions
Throw with slight force in a straight direction. Make sure the wings are level or slightly raised.

High Performance Dual Glider

This is actually two gliders in one! I have had never-ending fun with this glider over the past two years as it has so many different flight characteristics. It's the sort of glider I throw in a board meeting or cinema; no one knows where it comes from. It must be one of the best gliders I have devised yet, and I mean that sincerely.

1.
Use a sheet of A4 paper (or slightly less in length — about 210 mm x 287 mm). Crease paper lengthwise for the centreline, then fold the corners in.

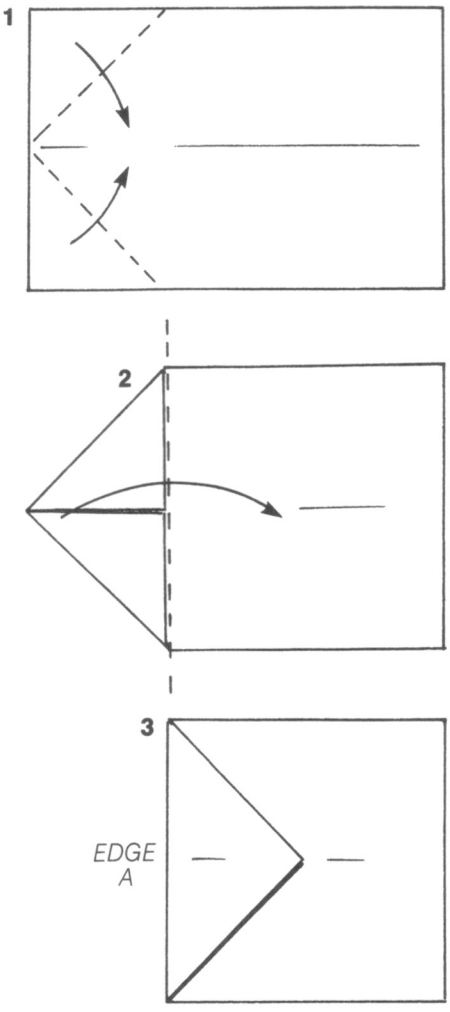
2.
Fold as shown.

3.
Turn paper over but keep the folded edge A to your left.

4.
Fold corners in again.

5.
Mountain fold in half.

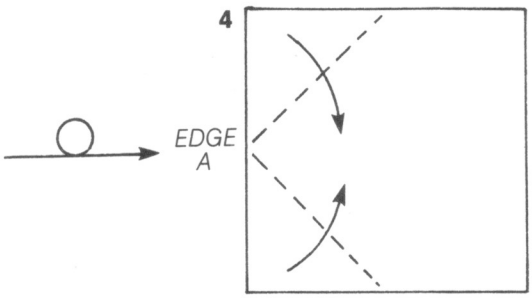
6.
To make the nose cone, fold the top flaps down from inside corner A to corner B.

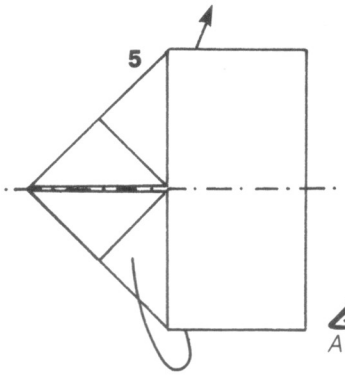


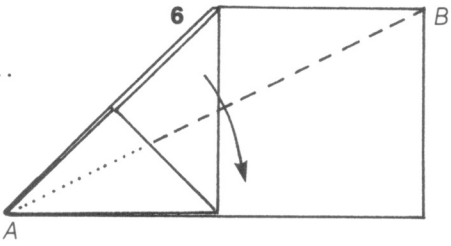
6½.
The step is half completed as shown.

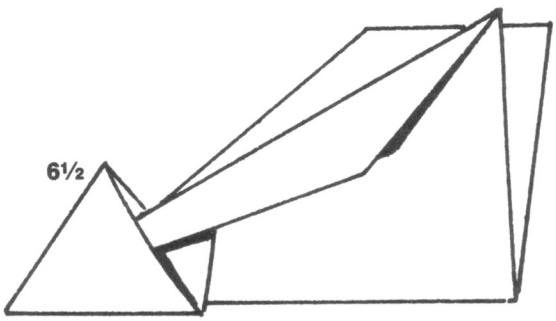
7.
What it should look like. Here you have the choice to make the glider version or the stunt version.
Glider version: *fold down the fins and angle them so that the fold points to the top point of the nose cone. Fold wings down and angle them slightly as shown.*
Stunt version: *fold up the fins parallel to base of fuselage. Add extra fin lift (if necessary) as shown in Advanced Concept 2. Fold top point of nose cone up, where it meets the wing and fold wings down parallel to base of fuselage as shown.*

8.
The finished Dual Glider — stunt version or glider version. Why not make both?

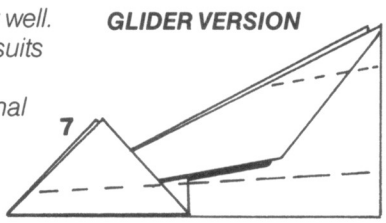


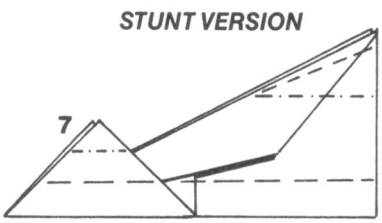


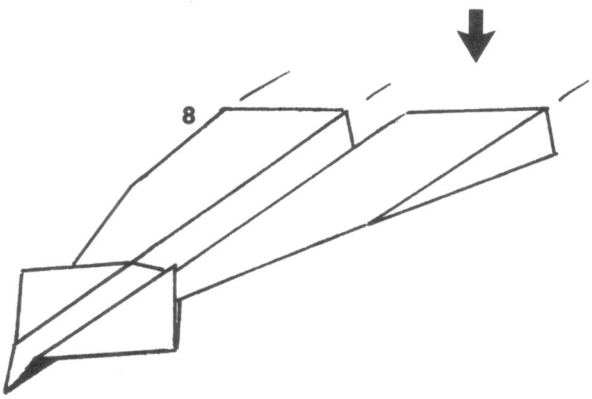


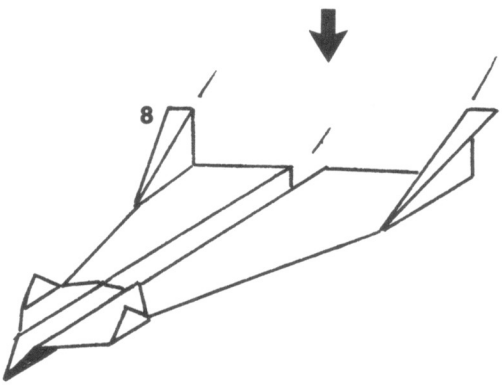


Throwing Instructions
Glider version: *throw steadily and with some force. The solid nose cone can take considerable thrust.*
Stunt version: *throw to make loops (big ones), circles, arcs etcetera, as demonstrated in "The Art of Throwing".*
Either way, both gliders fly well. Experiment to see which suits you best — you can even combine or change the final folds for some startling effects during flight!









Not-So-Simple Glider

Believe me — this may be slightly harder to make but it sure flies well! It features a good distribution of weight and a stability that's hard to match in normal gliders.

1.
Use a sheet of A4 paper folded in half lengthwise. Fold the left corners in as shown.

2.
Turn the paper over.

3.
Fold in half — left point folded all the way over to the right-hand edge.

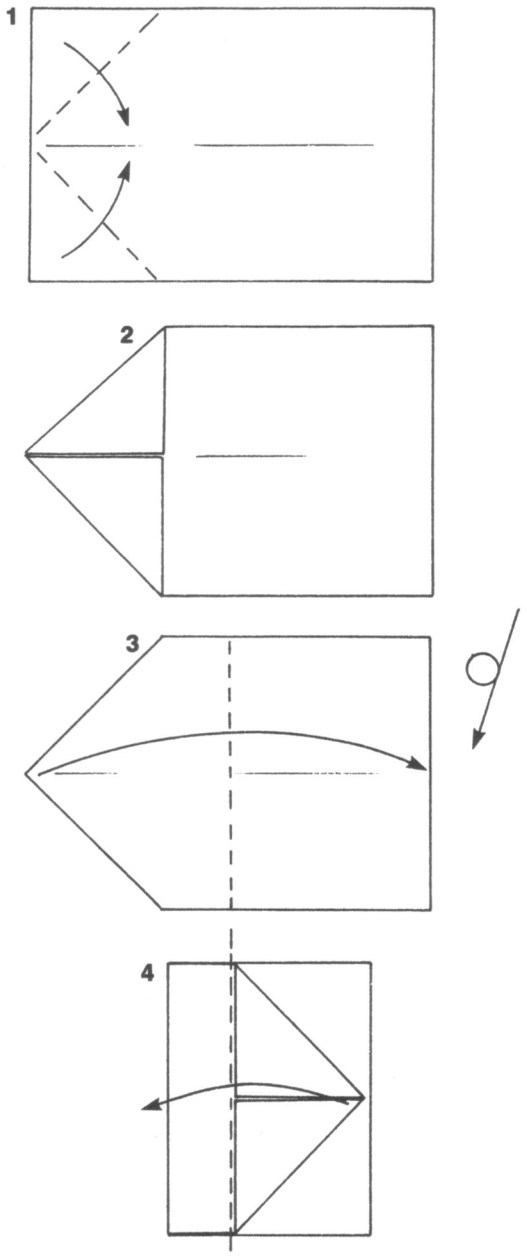
4.
Fold back as shown.

5.
This is what it should look like. Turn over.

6.
Here's the hard part: fold the corner in as for step 1, noting hidden fold, while bringing the nose fold round from behind.

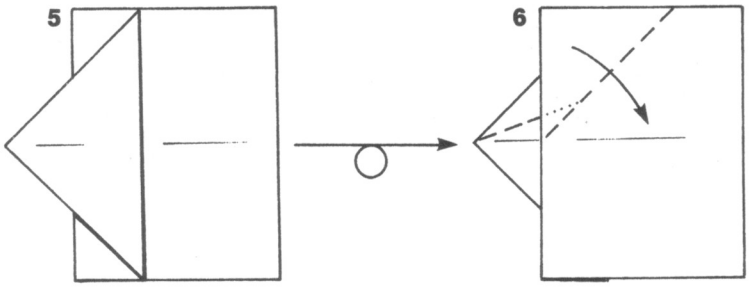
6½.
You're almost there, as shown in this larger diagram. Flatten the fold and do the same for the other side.

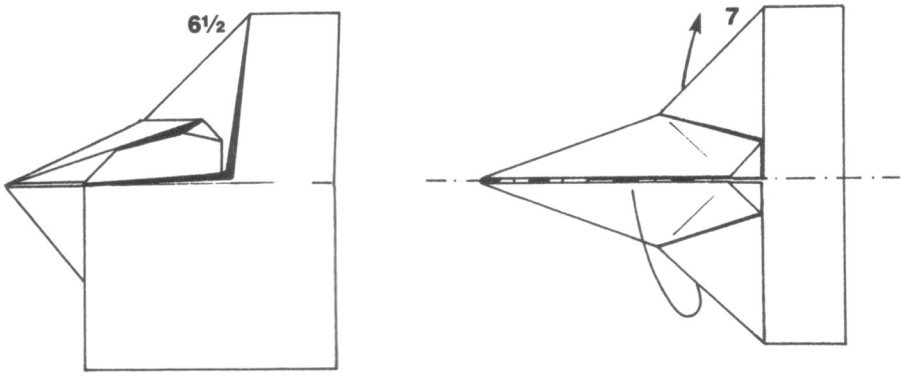
7.
It should look like this. Mountain fold in half.



8.
Fold the wings down as shown, slightly angled. Fold the fins down, angling the fold towards the nose of the glider. Invert the tail fin where shown.

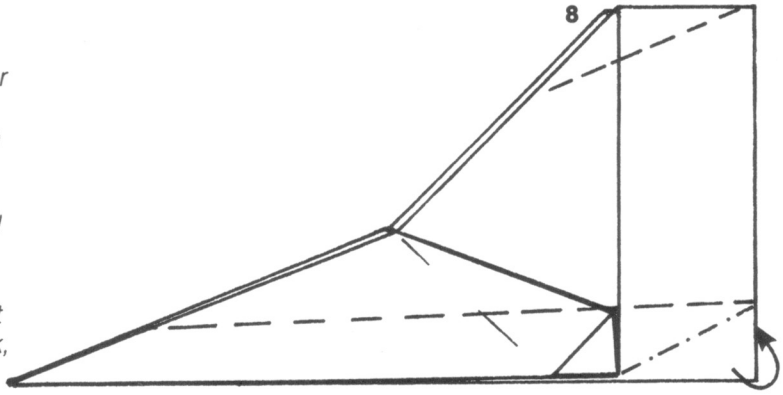
9.
It should now look like this. Now that wasn't hard was it?

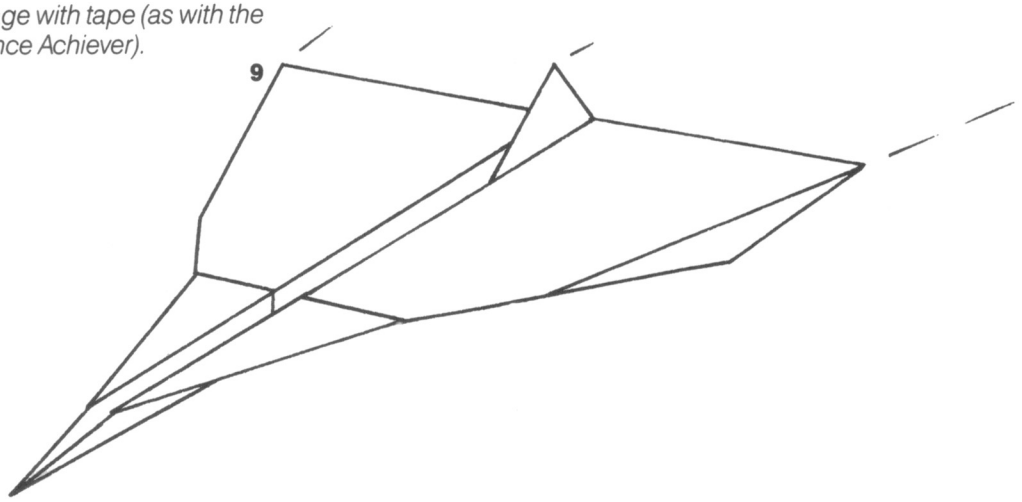




Throwing Instructions
Throw gently away from you for easy gliding. Throw harder, arcing your throw and it will do some amazing aerial manoeuvres. I'm sure you'll agree it flies well and is a good plane for practising folding techniques.

If the nose gets squashed, it can be folded under and back, tucked into a hidden flap on bottom edge of fuselage. You may wish to seal loose folds on fuselage with tape (as with the Distance Achiever).

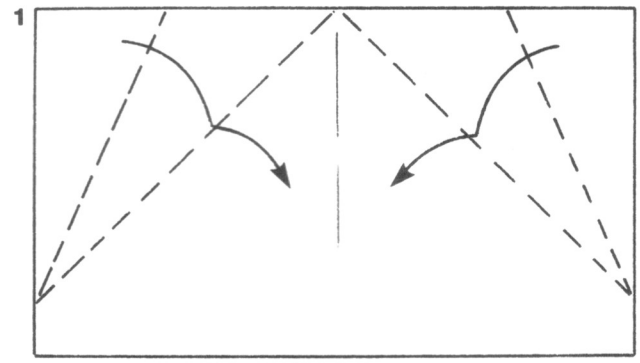


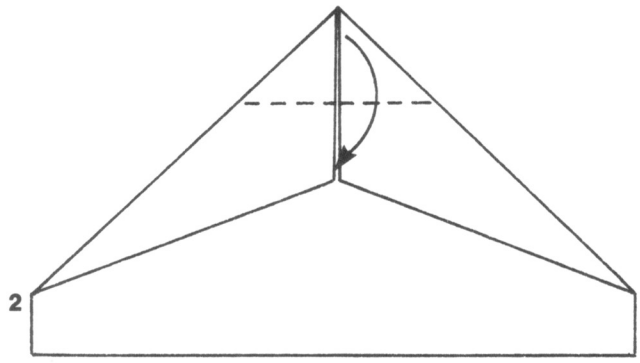


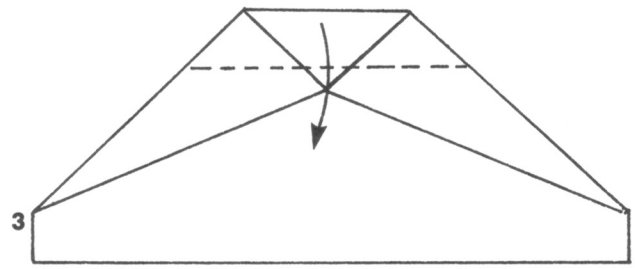
Windcheater

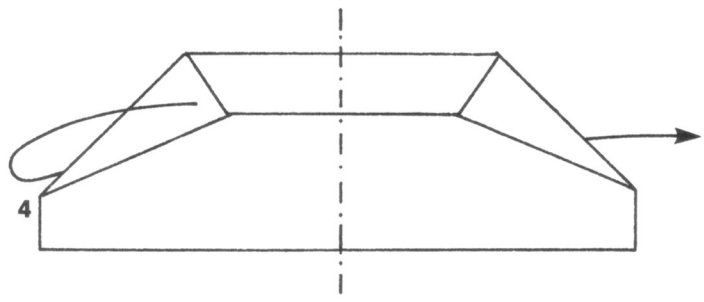
It's a sunny day. You're sitting on a park bench waiting for your loved one to arrive. You see her in the distance and decide to greet her with a paper glider. As you're about to fold, a stiff breeze whirls up from nowhere. The smoke from a gentleman's pipe wafts towards you while the bloke to your right lights up a cigarette. Dust is kicked up in the air. Someone breaks wind. "This is too much" you say until you see the nun to your left rolling her own. She strikes a match just as you strike an idea: "I'll make a windcheating aircraft!"

The professors may say "Why is it so?" but I only know that this craft will fly straight through not just moderate winds, but through any kind of pollution. Don't try it in a hurricane though!









1.
Use a sheet of foolscap facing you lengthwise, folded in half widthwise. Fold the corners in normally, unfold, then fold to the crease. Finally, fold over.

2.
Fold tip down as shown.

3.
Fold down as shown.

4.
Fold should be in this position. Mountain fold in half.

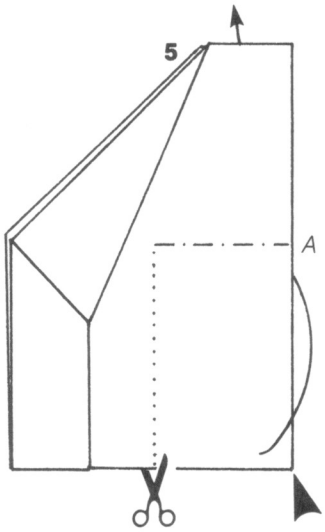
5.
Swing your glider around as shown (larger view). Halfway along fuselage cut upwards approximately halfway. See the mountain fold line? Invert the fold along this line but do not *crease the line well, A.*

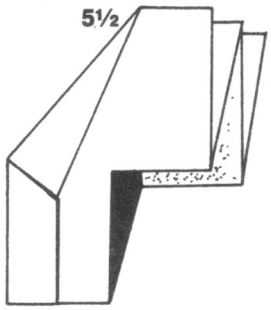
5½.
Almost there, as shown from rear-side view.

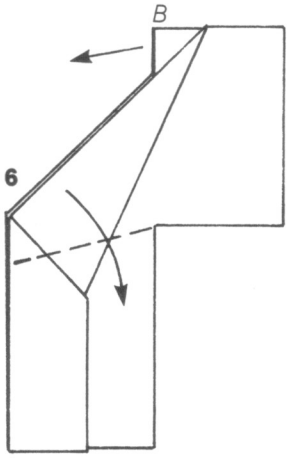
6.
Fold along line as shown. The new central fold should automatically move forwards, B.

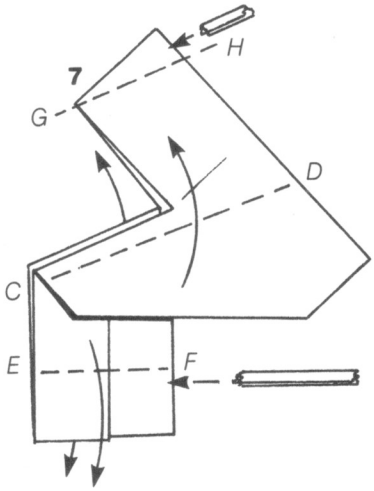
7.
First, fold the wings upwards (CD). Then fold the fuselage section EF giving about 2 cm fuselage height (or slightly more). Fold GH is a parallel fold to wings CD. Fold backwards and forwards to establish crease and seal together with tape. Seal fuselage together with tape. Note that sticky tape along EF and fold GH are optional, but will ensure full windcheating ability. The craft can of course glide normally without tape but it flies much better with tape applied to strengthen the folded configuration.

8.
Your finished Windcheater.

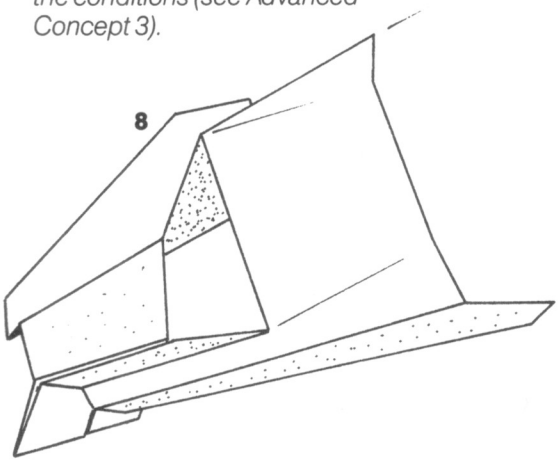


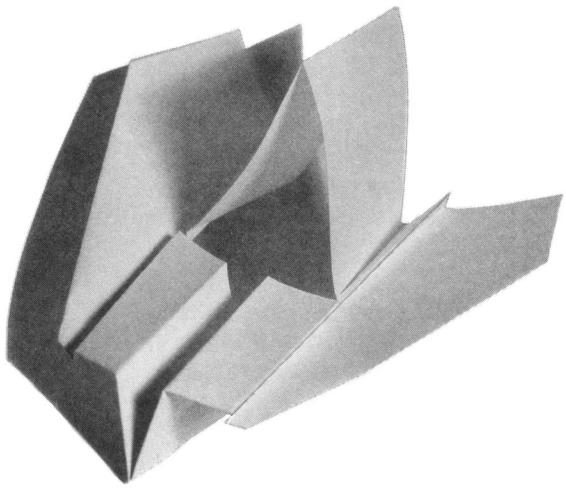






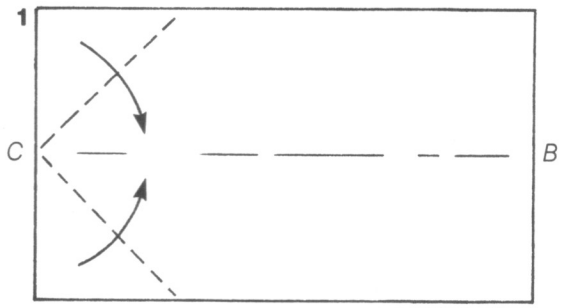
Throwing Instructions
Aim at target and throw with some force. Too much force will make it stall. Practise in light breezes first. (Wind direction is important too.) Your craft should glide well but may be tossed slightly to the left and right. If your craft does veer to the left or right, adjust the wing curl at the trailing edge of the wings to suit the conditions (see Advanced Concept 3).



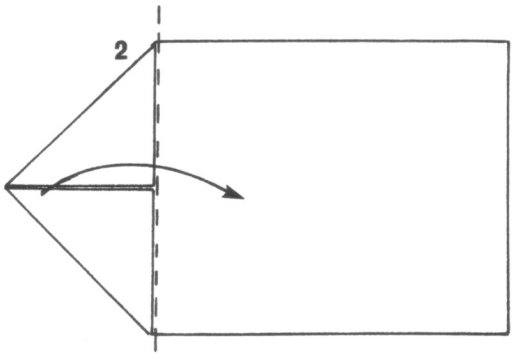


Litewing

This is an incredible glider that features a wing of one paper thickness. All the weight and throwing momentum is concentrated in the forward section so you can throw hard and make your craft go further. It is truly a dart of the eighties.

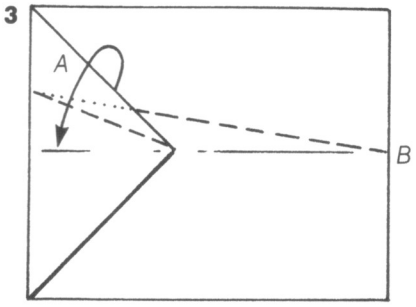


1.
A sheet of foolscap paper is preferable. Fold it in half lengthwise and fold the left corners in.



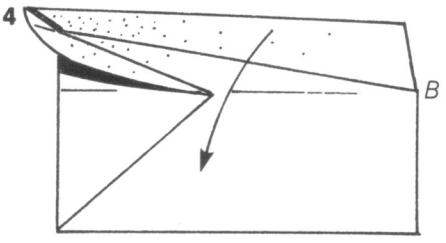
2.
Fold nose in.

3.
Tuck your finger inside the flap shown and fold the edge marked A over to meet the centre fold, bringing the whole flap behind over to the other side.



4.
You are almost there. Make sure that the fold going to point B doesn't go beyond the halfway crease.

5.
It should look like this. Fold upper flap upwards along CB which incidently should be exactly along the halfway fold as shown in figure 1. Repeat steps 3 to 5 for other side.



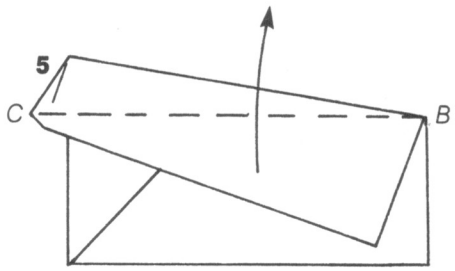
6.
This is what it should now look like. Fold the top forward flap back at the point where the hidden folds underneath meet, pushing in at point E. This is where the three folding lines shown meet.

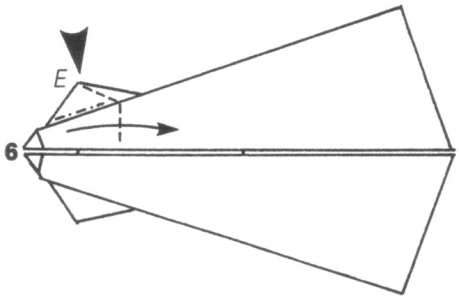
6½.
This larger forward section diagram shows the fold almost complete. Note where corner E is. Flatten the fold and do the same procedure for the other side.

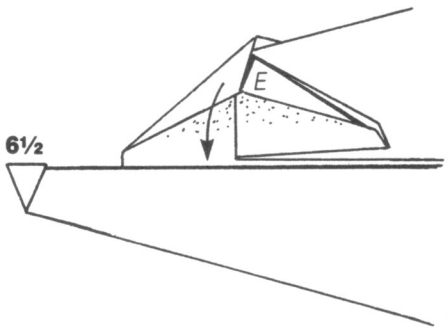
7.
Fold the bottom flap behind in half as shown.

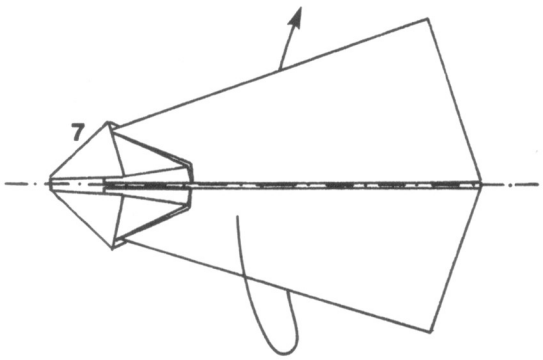
8.
By now, the whole fuselage is strengthened. To fold the wings hold both ends with fingers and thumbs, bringing wing edge over to meet fuselage bottom edge. Then crease the wing well. Folding the wing over by the ends first ensures no warping or misalignment of wing which could affect flight pattern. Do exactly the same for the other side.

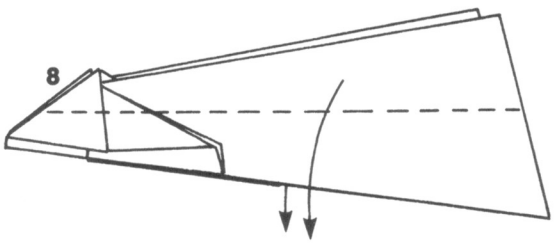
9.
The completed Litewing. If you are clever enough, there is a way to incorporate landing undercarriage in the forward section of the fuselage. I'll leave that to you!



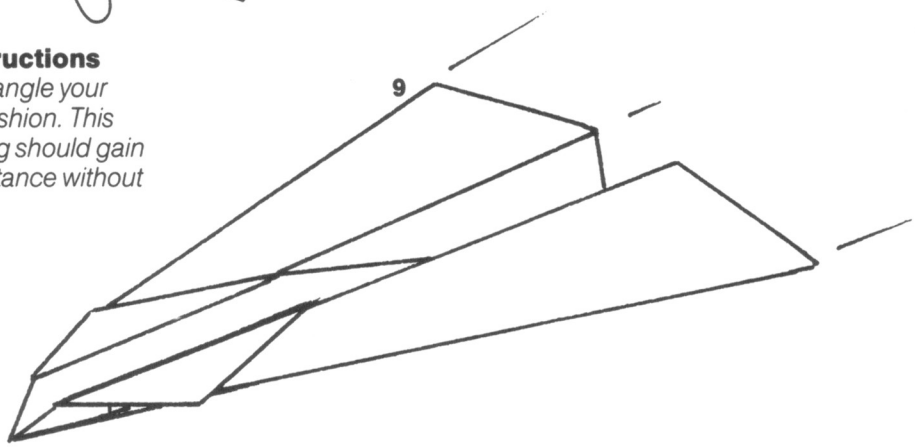








Throwing Instructions
Throw hard and angle your throw in an arc fashion. This way, your Litewing should gain considerable distance without stalling.



Ace Flier

While rummaging through my old notes and diagrams recently I discovered this design which I had invented at the age of 14. I decided to make the model and, with a few adjustments, I was delighted with the results. It is a paper airplane in every sense, with its lookalike wing and tail section — all made from a single sheet of paper!

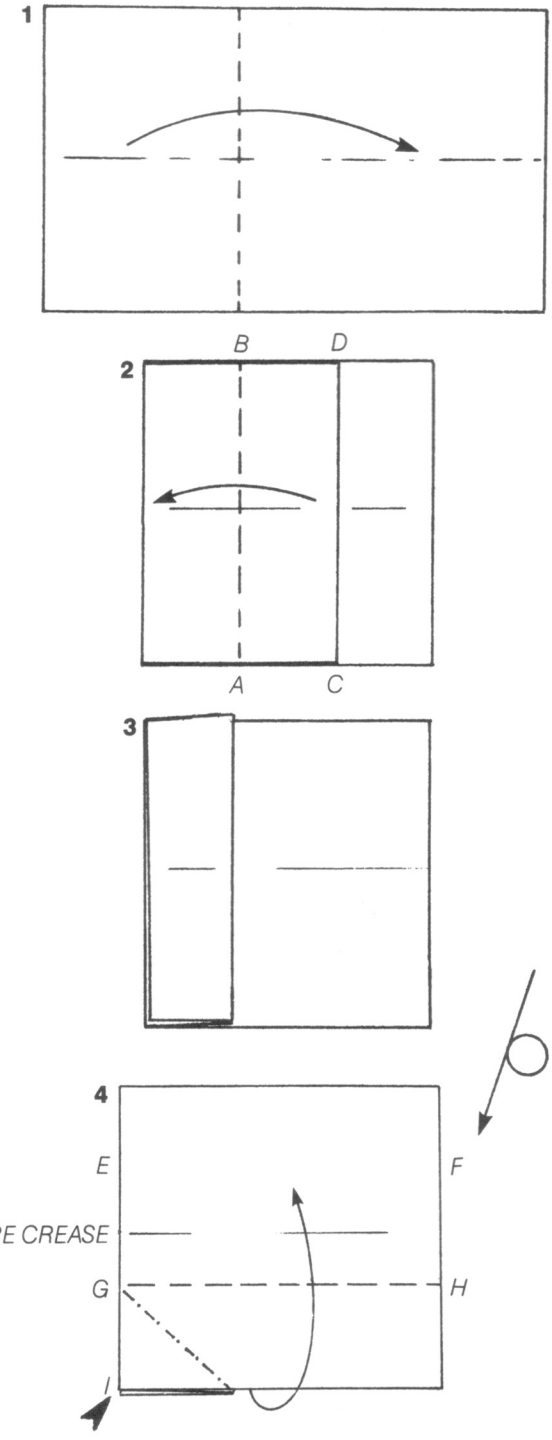
1.
Begin with a sheet of foolscap paper. For a better result, use a sheet which is slightly longer than foolscap (or trim a 2 cm strip off the edge of a foolscap sheet to make it dimensionally longer). Fold the end over so that when you get to step 2, you can mentally divide the paper into thirds. (I'm trying to avoid literal measurements.)

2.
You can see that AB is one third the length across from the left-hand side and that CD (the original paper edge) is two-thirds across. Fold along AB so that edge CD meets the left-hand edge of the paper.

3.
Turn the paper over.

4.
Larger view. Mentally picture the paper divided into thirds horizontally. Fold flap GH up to EF which is two-thirds up from the bottom edge of the paper. Corner I is brought inwards as indicated in step 5.

5.
Almost there. Do the same for the other side.



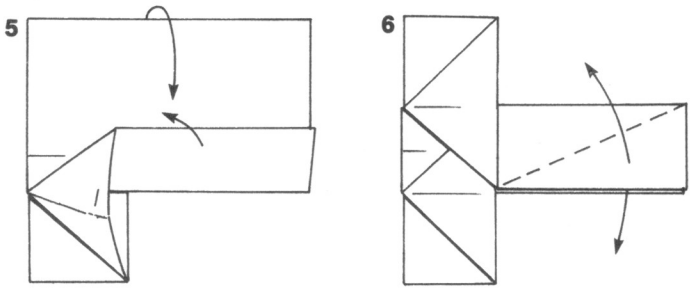
6.
Your model should look like this. Tail section — fold as shown and do the same for the other side.

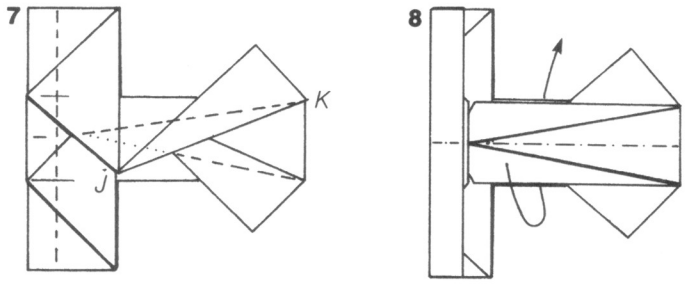
7.
Fold flaps JK back to the fuselage edges and do the same for the other side. Then fold over the leading edge of the wing as shown. This can be adjusted to suit balance requirements.

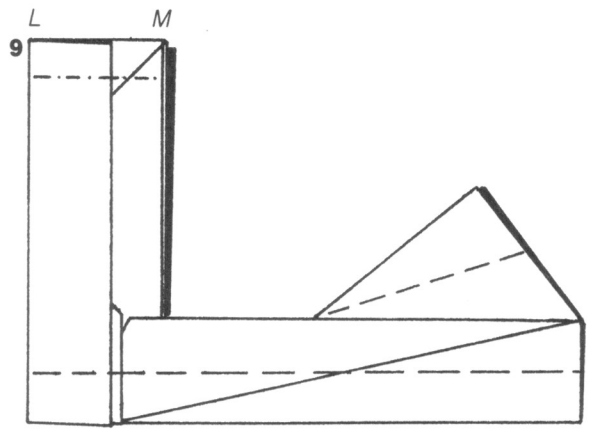
8.
Mountain fold in half in direction of arrow.

9.
Fold down fuselage section, fold down tail fins at angle shown and fold up leading wing fins where indicated. If the front wing span LM is too deep your plane could stall. Re-fold as in step 1 but make the folded flap slightly less in length.

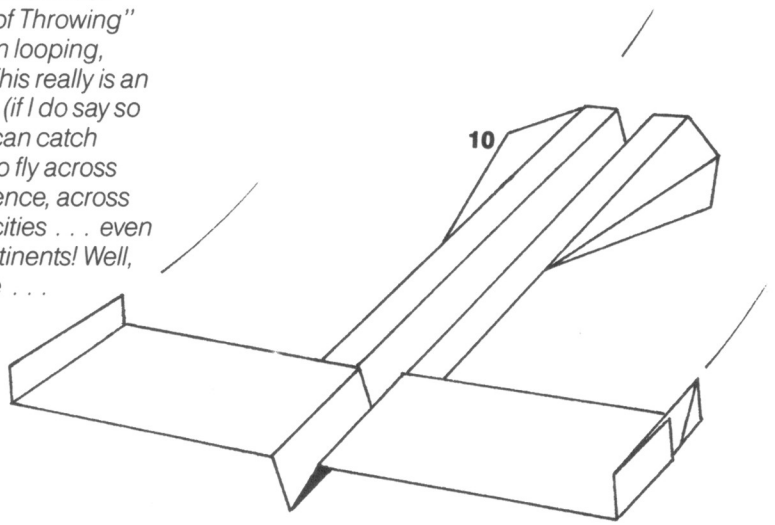
10.
The completed Ace Flier.







Throwing Instructions
Throw upwards (about 45 degree angle) for loops. Throw with force as the wings should be able to handle the thrust. Refer to "The Art of Throwing" for more details on looping, circles etcetera. This really is an incredible design (if I do say so myself), one that can catch upward breezes to fly across the neighbour's fence, across town, across the cities . . . even across whole continents! Well, would you believe . . .



The Hangar

And now for a little light relief — the Hangar — for the paper plane enthusiast who has everything (well almost). Visit your nearest newsagent or art shop and get a huge sheet of light cardboard (or tough paper). It will probably be supplied as a rectangle. The Hangar will have to be big enough to hold several planes. I suggest you use a normal size piece of paper to practise the folds first.

1.
Fold the sheet in half lengthwise. Now see the criss-cross valley folds? Crease along these lines. You will have established a centre point in which you can crease the mountain fold shown. Having creased these lines, place your finger into the centre point where all creases lead to and push in.

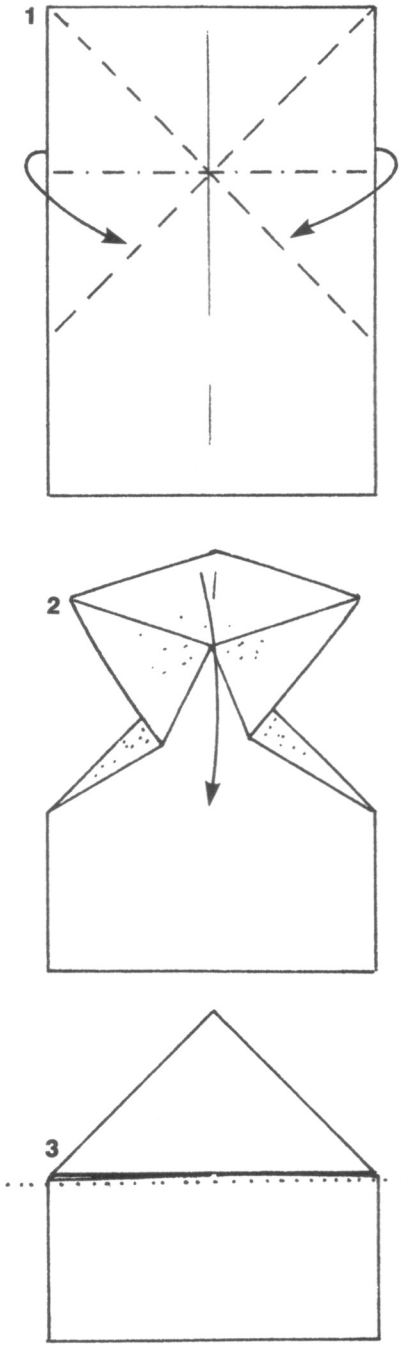
2.
The paper's edges should pop up. Bring the sides inwards and the top down.

3.
What it should look like. Cut off and discard tail end (or make a small glider with it).

4.
Lift top flap as shown, bringing in the sides.

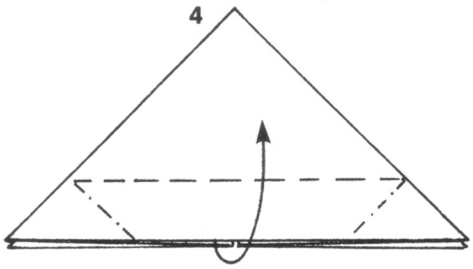
5.
Almost there.

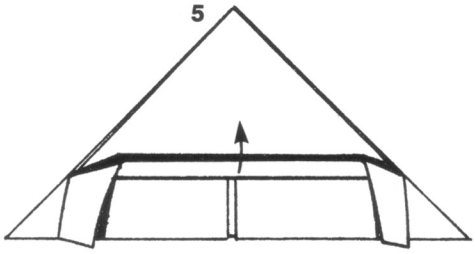
6.
Do the same for the other side.

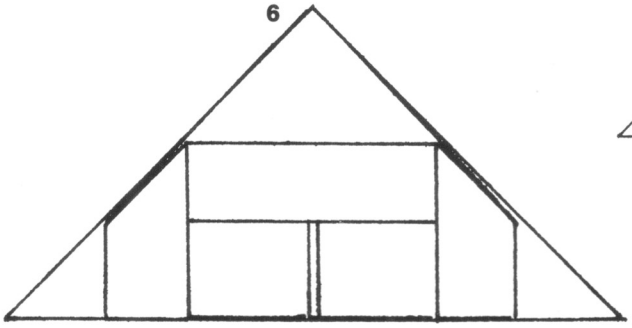


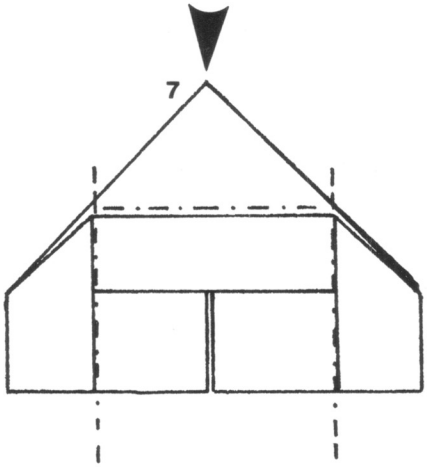
7.
Crease the sides vertically as shown. Crease the roof section backwards and forwards several times to loosen the paper. Push the roof down as you open the whole fold outwards (see "Folding Techniques").

8.
The completed Hangar.

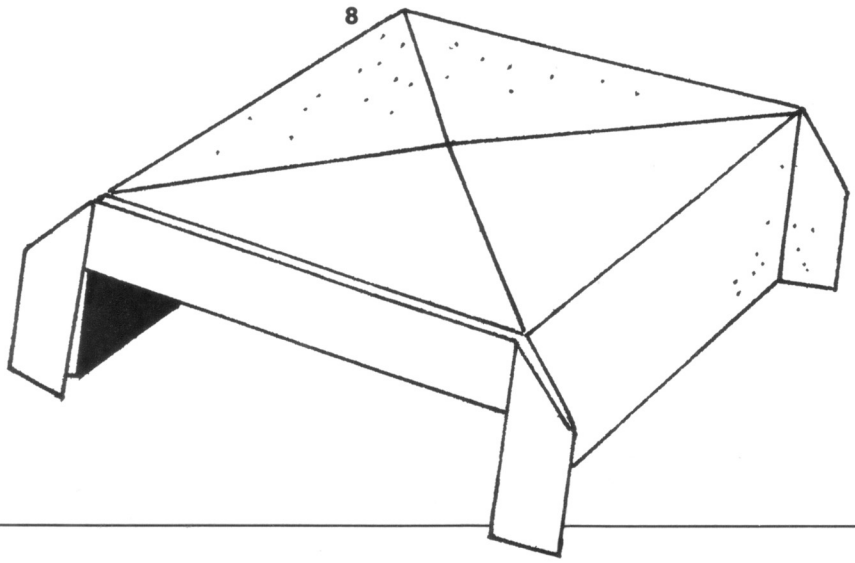


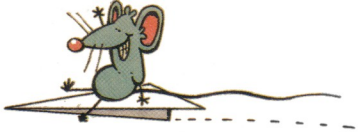






Throwing Instructions
Don't throw it! It's a Hangar — remember? Seriously, a large hangar can stop dust and grit from damaging your paper aircraft — especially if you want to keep a special glider for a competition. Kiddies of course will love the Hangar for paper planes, cabbage patch dolls, sticks of gelignite, Molotov cocktails . . .





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